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ABSTRACT

The Texas Educational Telecommunications Study examined problems and solutions involved in providing telecommunication support to education for the state of Texas. Extensive analyses were made in order to (1) delineate the objective that a telecommunications system should meet, (2) establish criteria that would be satisfied, (3) survey Texas problems and needs, (4) compile a statistical analysis of the results, (5) examine the existing networks and systems in Texas, (6) identify and describe successful systems in other states, (7) pinpoint factors effecting the availability and scarcity of software, and (8) propose hypotheses regarding the structures of educational technology and telecommunications 10 to 20 years hence. Among the conclusions of the study were: education would best be served by the expansion of an already extensive cable television network to almost all school campuses, the same network can provide narrowband channels for data transfer and computer-assisted instruction, such a combination could provide the greatest opportunity and flexibility for the least cost, and all programs of the Instructional Resources System would be serviced by the system. The recommendations stress that every effort should be made to expand the use of electronic technologies in the educational process. (SM)

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HOW NOW BROWN COW?

THE TEXAS EDUCATIONAL TELECOMMUNICATIONS STUDY

IR 002 339

PREPARED BY
THE EDUCATIONAL DEVELOPMENT CORPORATION AUSTIN, TEXAS
FOR THE
TEXAS EDUCATION AGENCY SUMMER, 1975

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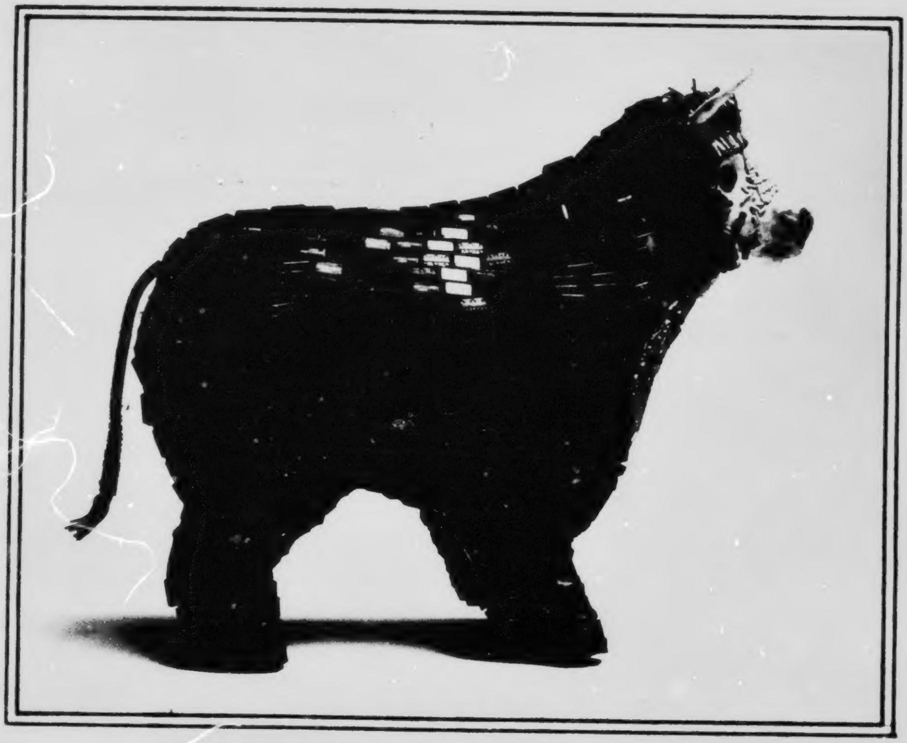

PREPARED BY
THE EDUCATIONAL DEVELOPMENT CORPORATION   AUSTIN, TEXAS
FOR THE
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This study has been prepared by

Educational Development Corporation
2813 Rio Grande
Austin, Texas 78705

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ABSTRACT

This report is the product of the Texas Education Telecommunications Study and reflects the problems and solutions involved in providing telecommunications support to educational technology. The study is, in fact, a context analysis--that is, it comprises the determination of whether or not a problem exists, specification of the problem, collection and analysis of information related to the problem, identification of possible alternative solutions, and evaluation of these solutions, followed by logical conclusions and recommendations.

In the process of carrying out this analysis, the authors delineated the objectives that a telecommunications system should meet, and, by examining all the various factors involved, listed the criteria that should be satisfied. A sampling survey was conducted to determine problems and needs; the responses to many questions were statistically analyzed, and trends were identified. Existing networks and systems in Texas were examined for possible use or extension, and successful systems in other states and other locations were also examined.

The factors and circumstances affecting the availability of software, as well as those relating to its inevitable scarcity, were identified. Finally, the structures of education, technology, and telecommunications during the period from 10 to 20 years in the future were hypothesized. (This period is viewed as the probable operating span for any technology selected today.)

The implications of all of these facts were brought together in an overall analysis, and specific technologies which failed to attain the objectives or to satisfy essential criteria were eliminated. Through further analyses and comparisons, the competing technologies were eventually reduced to five.

Texas has a strong commercial CATV system already in existence, and in the course of this study it became apparent that these nets could be extended readily and fairly inexpensively to reach almost all public schools. This would bring live and recorded audiovisual programs, whether local, regional, or network, into the classrooms. Additional narrowband channels, leased from within the same CATV network, could also bring CAI/CMI to each campus. These technologies seem durable and could even extend into home learning centers, thus augmenting the schools' capabilities. The technologies also offer fairly simple operation, decentralized planning (for local needs), greater individualization, and more teacher time freed for assisting and counseling students. And, finally, these methods are compatible with the needs and objectives of the Instructional Resources System for Texas.

The study places heavy emphasis on the need for proper planning, for full participation in the planning, and, most of all, for adequate planning for the change processes that must occur at all levels and with all personnel who are involved, either centrally or peripherally.

PREFACE

If any reader has stopped here to read the Preface, it is probably only out of curiosity about the title of the report and the expectation of finding an explanation for it. This is, correctly, the first order of Preface business.

Back in the early days of telephone communications, contact was frequently lost for a host of reasons. Re-establishment of voice communication was awkward, because the two parties involved could be sure of good contact only when they both could hear each other; thus, both had to keep trying as various adjustments were made. Rather than "Testing, one, two, three....", etc., or the more sophisticated "Can you hear me now?", the standard phrase was "How now brown cow?" This particular verbalism had the quality of repetitious assonance, a necessary characteristic because it frequently was difficult to distinguish the human voice from the multifold squeals, whistles, hums, scratches, blasts, howls, blurps, hisses, and other static that occurred on the line. If such a signal came through, the response was usually either the same phrase in return, or "I read you loud and clear."

To us, "How now brown cow?" has a similar significance--we see a need to establish communication at several levels. We see a need for educators (teachers, administrators, support personnel) to gain a better awareness and understanding of the technologies available, to initiate innovative programs and projects as a result of optimum decision-making, and to be able to use these methodologies and devices in a changing society with an ever-tightening rate of change. We recognize the requirement for these same educators not only to be unafraid of change themselves, but to convey this feeling to their students and to other persons as well. It is essential to bridge the generation gap in all areas, and it is important that all these improvements in communications take place within the realm of the proposed Instructional Resources System (a communications challenge in itself). For any or all of these events to transpire, we must first convince the reader that some action is needed.

Our study methodology has been what some educators call a "context analysis." In simple terms, a context analysis identifies and describes a problem, establishes its parameters, considers alternative solutions, separates out the chaff, delineates options, and points out the most likely directions in which to proceed. We spent nearly half of the nine-month term of our contract delimiting and describing the problem and collecting and organizing information. Several weeks were then devoted to consolidation, review, analysis, and discussion, together with periods of writing and rewriting. Our course was circular, in the sense of returning to subjects and refining, rather than moving in a straight line from start to finish. Some portions of our discussion, rationale, and conclusions were written several times, with each version representing an improvement based on new findings of some other facet of the study. Our product, if and when approved, should lead to a phase of specific planning for implementation.

How can the reader know whether to believe everything here? Another communication problem! For we must attain credibility and maintain it throughout. We realize, of course, that we could end up pleasing no one, and that would be unfortunate. We have tried to present our thinking and its results straightforwardly, and we believe that we have taken all the right steps to do a good job. In the relevant literature, we have reviewed over 400 documents, and have abstracted nearly 300 of them for the whole team to review. Several hundred letters have been written to obtain specific facts or determine general attitudes. Teachers, administrators, and support personnel throughout Texas have been spot-checked for needs and attitudes. And hundreds of hours, indeed, hundreds of days, have been spent in acquiring, reviewing, comparing, selecting, grouping, and amalgamating the various data to focus more clearly on viable alternatives. We offer no apologies for the outcomes or the final product; actually, the effort and depth of this study are substantially more than what was specified or, probably, what is anticipated by the Texas Education Agency.

Members of the study team were selected for their knowledge of, and the valuable contributions they have made in, specialized areas of communications, technology, and education. Together, they bring to the study over 150 years of combined experience in these areas. Specific portions of the report were prepared by each team member, but others contributed their ideas and often their own words. We agreed not to identify the author of any one portion; thus, equal credit (and blame) must be given to the entire team:

Russell J. Carey, Jr.
Billie Grace Herring
George M. Higginson (study director)
Heidi Kaska
Reeve Love
Mark T. Muller

Others who made specific contributions are: Carol Brown, Marion McCord, and Louella Wetherbee, in research and abstracting; Tom Eisenhour, Harry Hartley, and James R. Holmes, in preparation of maps, graphics, and illustrations; and the personnel of KLRN, the Region XIII Education Service Center, the Austin ISD, IBM, Bell Telephone, the State communications office, and innumerable other commercial, educational, library service, and communications agencies. To Robert E. Shutes, from Texas A&M University, we owe special thanks for putting us back on the track occasionally.

One always wonders if anyone ever reads this type of report, cover to cover, and if so, who and where. Thus, if questions arise, or suggestions develop, we would be happy to have them. Our address is on the reverse of the title page.

73's

and/or

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George M. Higginson
Austin, July 1975

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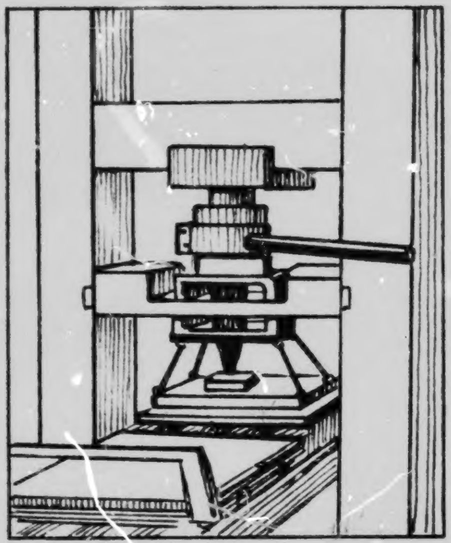
I

introduction

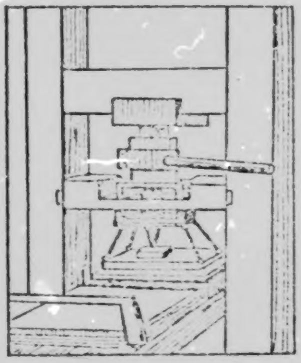


PRÉCIS

This introduction, like most others, presents an overview of the report and indicates something of the study methodology and process. However, it also places heavy emphasis on the question of change, and tries to highlight the overall need for change as well as the fact that the correct approach toward change is a critical requirement.

The introduction mentions the broad fields of concern that impinge on the entire study, and explains why they must be studied simultaneously with the technology. These areas are political, strategic, organizational, financial, and human. There are also subsidiary issues of compatibility, obsolescence, local planning, local participation, centralization or decentralization, and evaluation. These various factors, properly considered, decided upon, and planned, can made a valuable contribution to the eventual success of a proposed undertaking. Lack of proper accommodation, however, gives any one of them opportunity and license to cause failure. Thus planning not only for the innovations themselves, but also for the creation of the conditions and methodologies that will impel and facilitate the change process, is essential.

Examination of the two charts that accompany this chapter will indicate the sequence of the study, the purposes of the different chapters, and the convoluted nature of this type of study, re-examining, reorganizing, and revising, with a constantly sharpening focus.



I

INTRODUCTION

In today's world, changes of all kinds are occurring at such a phenomenal rate that it is almost impossible to predict them accurately, and certainly impossible to control them fully. Immense changes have taken place and will continue to take place in science, in medicine, in agriculture, in economics, in social interaction, in education, and in the very nature and quality of the environment which surrounds us all. Learning to live with these changes where appropriate, to accelerate them where desirable, or to retard them where necessary is perhaps the most important capability we can presently develop, both in ourselves and in the children we must educate today to face an uncertain future.

Further, many of the ongoing changes themselves have a direct and critical bearing upon the kind of education we must provide. In a world where the amount of scientific information available is increasing explosively and exponentially, it is no longer possible to expect a student to master the "facts" of a particular discipline. In a society where stereotypical sex roles are gradually dissolving, it is no longer possible to categorize learning activities in terms of "masculine" or "feminine" interests or professions. Instead, students must be taught in ways that will enable them to develop a broad understanding of learning processes and techniques, as well as an awareness of the many options that may be available to them. With regard to educational technology itself, the state of the art has been and will continue to be a major factor in determining the kind of education we should be able to offer. The use of the newer electronic technologies is expanding rapidly in business and industry and even in the home, and these same technologies are equally available for classroom use. Many of them, however, are costly to install and implement, and their potentials must be clearly understood and their cost-benefit ratios critically examined before intelligent choices can be made among them. There is no doubt that some can and will be used in the classroom to great advantage, but the process of decision-making will be a difficult one and one for which the participants must be suitably prepared.*

What all this means, then, is actively planning for change and incorporating it into the educational process, instead of resisting it as something to be feared and avoided as long as possible. Only through careful planning can change be dealt with smoothly and productively, for without such planning it is indeed likely to result in confusion and chaos rather than progress. Value systems must be clarified and priorities established so that alternative futures can be examined intelligently and their complex consequences weighed with some degree of accuracy. The educational community must look at where it is presently going and what it actually wants to become, so that it can continue to ascertain the rapidly changing needs of its clientele and to serve these needs as best it can. To the extent that the future can be predicted by astute forecasting, it can be guided by good planning.

---

*Goldman and Moynihan, in a survey of 156 New York school districts, show that 40 percent of the total problems encountered in ISD planning involved "gaining commitment to planning and change." This was also the largest single problem in such planning.

NOTE: Hereafter, references will appear at the end of each chapter, rather than in footnotes.

Since the basic purpose of all planning is to effect some kind of change, it is essential that the planners themselves understand the change process, that they know the various ways of instigating change, and that they can determine which method(s) will be most effective in a given situation. Systematic planning involves the establishment of priorities, as mentioned earlier; it also involves determination of necessary resources, program coordination, facilitation of decision-making, re-examination of original assumptions, assessment of the existing political climate, prediction of problems, and identification of voids in ongoing efforts which might be filled by additions to the program or by new programs. The planning process must involve people at all levels who are affected by the program, and it is never complete, as re-assessment and re-establishment of goals and objectives must continue along with program implementation.

To say that we can, to a certain extent, use this planning process to control the kind and rate of the changes that take place in our world is to raise a number of related questions and pose a number of inter-related problems. For example, can predicting a particular change actually affect the occurrence of that change, either positively or negatively? Many advances in space technology followed the predictions that they could and would be made and the decisions that indeed they should be made; on the other hand, dire predictions of imminent environmental disaster may have helped to slow down, although not to stop entirely, the thoughtless plunder of many of our natural resources. We do not yet fully comprehend the extent to which we can cause change, nor do we yet know precisely how to control the rate of change. While the rate at which new ideas and new technologies gain acceptance and come into use grows faster and faster, the rapidity of their obsolescence also continues to increase, and there is still sufficient lag between invention and acceptance to make this a problem. The problem is especially acute when informed choices must be made between a number of innovative philosophies and techniques, as well as between the old and the new. Again, the ability to predict likely consequences and subsequently to select intelligently from an array of alternative futures is one which we must inculcate in ourselves, as educators of one type or another, and in the young learners we ultimately reach.

In setting the change process in motion to introduce an innovative technology, the planner encounters a number of special, additional problems. Beyond the initial cost of the technology, which is probably the most basic consideration in most cases, such factors as durability, simplicity of operation, ease of maintenance, and extent of associated requirements for personnel, software, and supplies must also be considered. In the area of software, the question of availability is a continuing and major problem, for no technology can be used successfully as a teaching tool if it is given nothing useful or important to teach. Introduction of a specific technology brings with it a host of inter-related activities, and planning for such a change and anticipating its consequences is a highly complicated process.

In addition to the inherent factors mentioned above, there are also numerous subtle factors that must be considered. For example, the political feasibility of the innovation is of critical importance. Public relations efforts may need to be undertaken to build support for it, or certain legislation may need to be enacted to provide a solid base for it, or it may simply not be feasible at all for the particular place, time, and target population. Organizational and strategic factors are also extremely significant in determining the success or failure of an innovative technology. Planning for introduction of the technology requires decisions concerning the source and nature of policies affecting it, the methodology for its overall coordination and for continuing planning, the desirability of centralization or decentralization of its implementation, and the necessity for developing new skills in the personnel who are to implement it. Finally, continuing financial considerations must be given major importance. Sources of funding must be explored, percentages of funding to come from federal, state and local levels determined, and maintenance and replacement costs calculated.

Overall compatibility, moreover, is an extremely critical consideration in the introduction of any innovative educational materials and/or methodologies. Such innovations must fit in, in terms of purely technical requirements, with extant technologies and the systems they comprise; they must interact smoothly and productively with these systems in order to attain mutual objectives; they must fit into overall state plans and work toward predetermined state goals; and they must further national educational aims as well. This degree of compatibility is admittedly difficult to achieve for any newly introduced technology, but it is essential if the total educational program is to function effectively.

Consideration should also be given at this point to the degree of centralization which should exist in a state educational system, and to the amount of control which should be vested in the state itself. Conceivably, the state could own and operate all the various technologies which make up its educational system, it could subcontract to private owners or a state subsidiary corporation, or take one or more of a number of intermediate routes. All decision-making could come through the central state agency, or a number of key decisions could be made at the local level. These matters may be decided on the basis of precedent and established pattern, but they must at least be considered before important educational innovations can be implemented.

Throughout the effecting of educational change through the use of technology or of any other innovative tool, those who function as planners and change agents must keep the welfare of the students foremost in their minds. The ultimate aim of all proposed innovations is, presumably, better education for all learners, and this must be the ultimate criterion in their selection, implementation, and continuing education. The learners themselves should be given a continuing opportunity to make input to this evaluation, and as many decisions as possible made at local levels where their needs are best known, so that further changes will keep them provided with technology, methodologies, and, most importantly, software that are useful, current, and compatible with the original innovations. Finally, they themselves must be made cognizant of and comfortable with the change process, so that they feel free to initiate and manage their own intellectual growth whenever possible. Only in this way can the entire system remain responsive to their changing requirements, and only in this way can the process of innovation truly be one of improvement.

The present study functions as a sort of prelude to the initiation of planning and change processes in the Texas public schools; its scope is outlined in the following chapter, and its general schema comprises Figure I-A. Despite the straight-line appearance of this schema, it is actually a circular, convoluted process, returning frequently to the same topics for refinement, sharper focus, and examination at a different level. Although this report cannot reflect such a process in linear narrative, a rather crude illustration of its nature is shown in Figure I-B.

STUDY SCHEMA

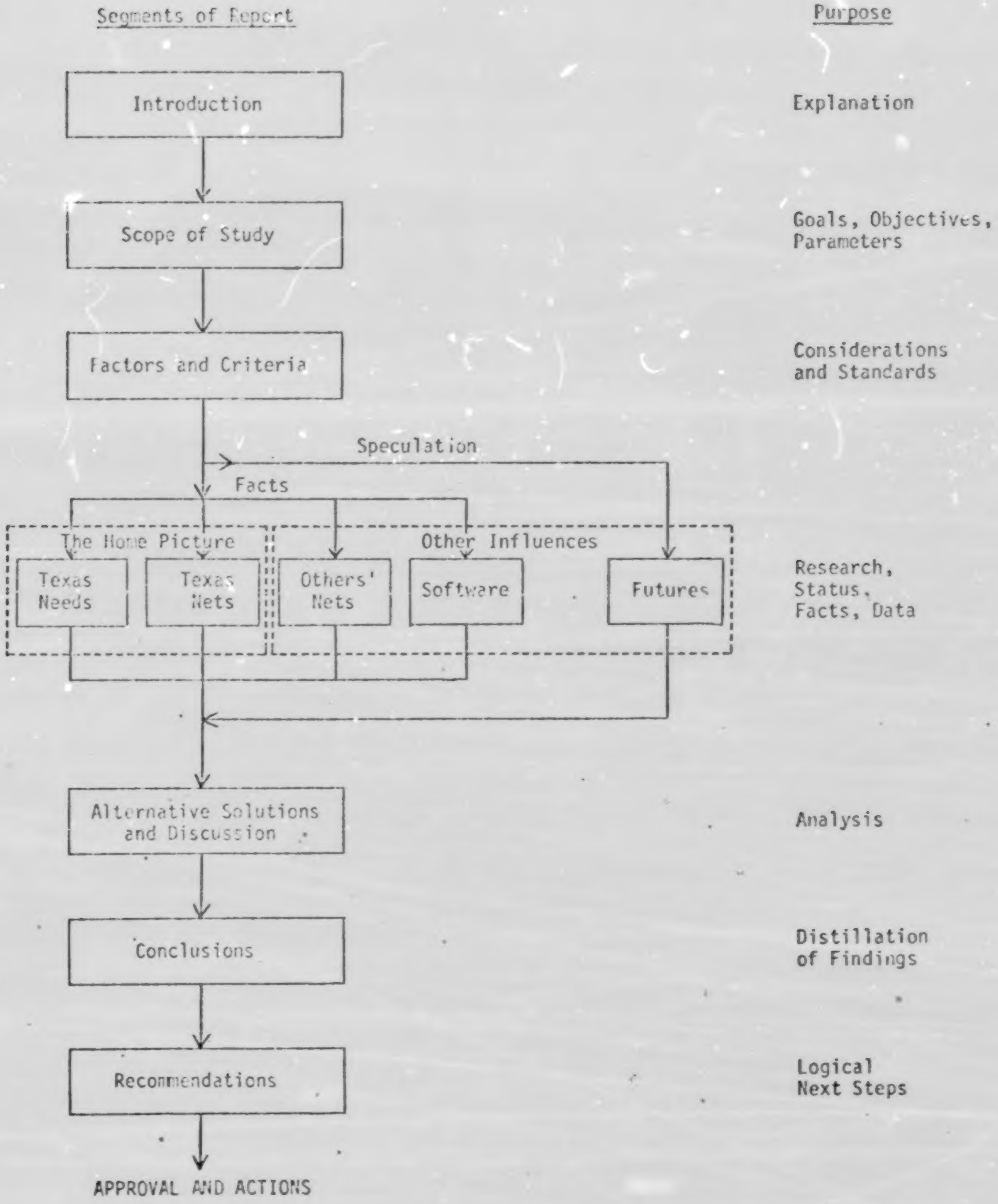

Segments of Report
Purpose
Introduction
Explanation
Scope of Study
Goals, Objectives, Parameters
Factors and Criteria
Considerations and Standards
Speculation
Facts
The Home Picture
Texas Needs
Texas Nets
Other Influences
Others' Nets
Software
Futures
Research, Status, Facts, Data
Alternative Solutions and Discussion
Analysis
Conclusions
Distillation of Findings
Recommendations
Logical Next Steps
APPROVAL AND ACTIONS

Figure I-A

THE STUDY CONVOLUTION

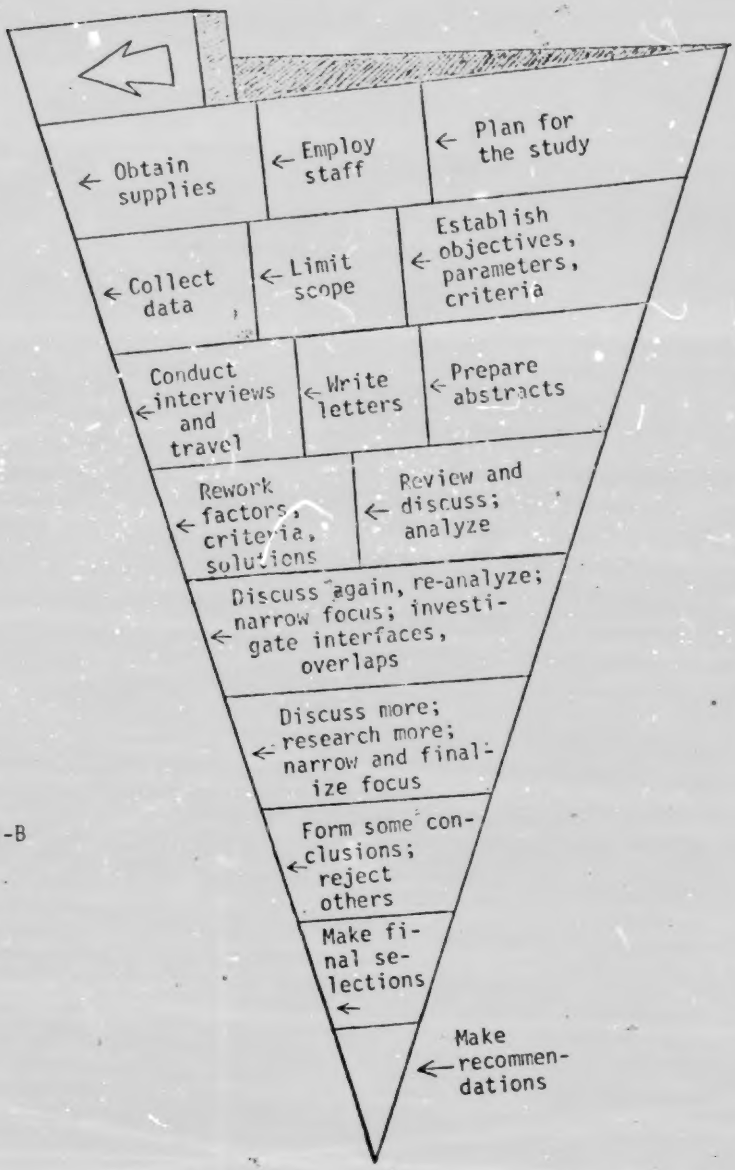

← Plan for the study
← Employ staff
← Obtain supplies
← Establish objectives, parameters, criteria
← Limit scope
← Collect data
← Prepare abstracts
← Write letters
← Conduct interviews and travel
← Review and discuss; analyze
← Rework factors, criteria, solutions
← Discuss again, re-analyze; narrow focus; investigate interfaces, overlaps
← Discuss more; research more; narrow and finalize focus
← Form some conclusions; reject others
Make final selections ←
← Make recommendations

Figure I-B

CITED REFERENCES

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II

scope

PRÉCIS

This chapter sets out to delimit the problem of telecommunications as related to educational technology as well as to establish parameters for the study of the problem. It begins with a definition and discussion of telecommunications and educational technology; this is followed by an explanation of context analysis and then by the objectives of this study:

(1) To identify statewide needs for technology;
(2) To identify the potential users;
(3) To study the technologies and networks already in use in Texas;
(4) To study educational telecommunications in other states;
(5) To forecast probable future directions of educational technology;
(6) To make findings and recommendations.

A discussion of integration of this study with the Texas Instructional Resources System follows, and then the objectives of any telecommunications in support of educational technology, which are:

(1) To provide general information to teachers;
(2) To provide in-service instruction and training for teachers;
(3) To provide updating of technological information on a regular basis to teachers and to administrators;
(4) To carry instructional and enrichment items for students;
(5) To store and transmit a variety of administrative data;
(6) To provide management information suitable for decision-making.

The next discussion covers nine basic assumptions of the study, relating to the following subjects:

Information flow
Ethics
Societal changes
Expanding technology
Continuous education
Educational accessibility
Educational informality
Educational changes
Interaction of education and information

Next, there is a discussion of time frame, so that the reader will understand why we are looking at a period 15-20 years in the future. Finally, the chapter ends with an identification of the purposes of the following chapters. These chapters are:

Criteria and factors (III)
Needs survey (IV)
Existing Texas networks (V)
Others' networks (VI)
Educational software (VII)
Forecasting the future (VIII)
Alternative solutions (IX)
Findings and conclusions (X)
Recommendations (XI)

II

SCOPE OF THE STUDY

This report describes a context analysis study of Texas educational telecommunications performed by the Educational Development Corporation under contract with the Texas Education Agency. A network of statewide telecommunications may be critical to the comprehensive Instructional Resources System for Texas conceptualized by the Agency, as a support system for the Technology and Dissemination Program, and the current study examines the needs for such a network and the requirements for its development if it is to be undertaken.

The mission of this study has been severalfold: to review the work already done on telecommunications networks and to bring the information available on both needs and technology up to date; to do rigorous forecasting of the telecommunications and technological future and relate the results to the proposed Instructional Resources System; and, finally, to determine the most feasible alternatives that are available, to perform a critical examination of these alternatives, to make recommendations that can serve as the basis for further state planning, and to provide a discussion of the considerations that will be essential if such planning is to take place.

Before proceeding further, it is necessary to define exactly what is meant by telecommunications in the context of this report. Telecommunications, using a definition formulated by the Committee on Telecommunications, National Academy of Engineering, and subsequently adopted by the Texas Education Agency,

> ...is any transmission, emission or reception of signs, signals, written images and sounds or intelligence of any nature by wire, radio, visual, or other electromagnetic systems including any intervening processing and storage. (Attributed to the Committee on Telecommunications, National Academy of Engineering, quoted by the Texas Education Agency, A Special Study of Telecommunications/Television, 1972)

According to the Agency, "This definition encompasses radio, telephony, computer-assisted instruction, television, audio and video recordings, or a combination of these media." (TEA, A Special Study of Telecommunications Television, 1972)

Telecommunications, both within the context of this study and within the broader purview of educational thought, constitutes only one aspect of what we call educational technology. Educational technology has only rather recently begun to emerge as a discrete field, and definitions are still tentative and varying. The term may be used to describe

> ...the audiovisual materials and equipment used by teachers to supplement traditional instruction (e.g., films, records, television, computers, and overhead projectors) (Chisholm and Ely, 1974)

or it may imply a more comprehensive and systematic approach to the entire educational process, as follows:

> Instructional (educational) technology is a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication, and employing a combination of human and

> nonhuman resources to bring about more effective instruction. (From the *Report of the Commission on Instructional Technology to the President and Congress of the United States*, quoted by Chisholm and Ely, 1974)

This latter definition is more consistent with the overall purposes of the Instructional Resources System, in that it emphasizes the importance of developing a broad range of educational resources, and of systematically applying these resources to promote learning by the individual. These are the basic aims of the Instructional Resources System as well, and it is within these comprehensive goals that the more specific objectives of the Texas Educational Telecommunications Study have taken shape.

A context analysis study such as this one is not designed to supply solutions for which educational problems must subsequently be identified, but rather to begin by identifying the various kinds of small requirements which cannot be met on an individual basis throughout the state, but which could conceivably be met through the efforts of a coordinated system. To this ultimate end, educators will have to perceive the sorts of problems they are having, to consider the possible solutions for these problems, and to cooperate in the implementation of some of the most feasible of the solutions. It does not follow that any solution will be equally applicable to all users; rather, each community will probably require a mixture of several solutions which have been selected for its specific needs.

The objectives of this study, then, have been as follows:

(1) To identify statewide needs for the kinds of telecommunications technology delineated earlier:
    (a) To summarize information already collected and analyzed;
    (b) To augment this information with more up-to-date knowledge;
    (c) To ensure that persons contacted by survey or other correspondence are aware of all educational options, technological and other; that they understand the advantages and disadvantages of each; and that they consider current forecasts of future developments in both education and technology when they make their responses;

(2) To identify the potential users of various technological solutions to the perceived needs, in terms of:
    (a) Number;
    (b) Location;
    (c) Intensity of use;
    (d) Grade levels;
    (e) Subjects and courses;

(3) To delineate the technologies and networks already in use in Texas, and to examine their costs, current extent of utilization, potential for expansion, flexibility, compatibility, and general success or failure;

(4) To study the existing or planned educational telecommunications of other states; and to provide a review of population densities, number of users, cost per pupil per year, and success or failure of each state system;

(5) To forecast the directions educational technology is likely to take for the period five to twenty years in the future, in order not to build obsolescence into a projected system;

(6) To make findings and recommendations which will be the foundation for any subsequent planning activities.

The study has taken the form of a context analysis because context analysis, which includes needs assessment, is usually the first step involved in developing, or even conceptualizing, any new program or system. This is a data collection phase which defines and delimits the problem at hand by collecting, analyzing, and reporting all relevant data. Subsequently, tentative solution ideas are discussed and the better ones retained in the form of recommendations on how to proceed. Context analysis is followed by planning for implementation, and then by implementation, evaluation, revision, and continuing operation. Thus, this study has been a necessary prelude to planning what may prove to be a critical support function for the proposed statewide Instructional Resources System.

Like the Instructional Resources System, this study limits itself, in essence, to the Texas public schools. However, other potential user institutions must be considered in dealing with logistics, cost/benefit analysis, and overall coordination of any viable statewide telecommunications system. Without financial and/or logistic support from users both inside and outside the field of education, such a system may not even be feasible, and without strong central coordination of all prospective users, it will certainly be neither efficient nor effective. Therefore, some considerations of this nature have been incorporated into the study, and some basic requirements which any statewide educational telecommunications system should meet have been set forth as follows, stated as system objectives and not in any order of priority:

(1) The system should be able to provide general information to teachers;

(2) The system should have the capability for providing in-service instruction and training for teachers;

(3) The system should provide updating of technological information on a regular basis to teachers and to administrators;

(4) The system should carry instructional and enrichment items for students;

(5) The system should be able to store and transmit a variety of administrative data;

(6) The system should be able to provide management information suitable for decision-making.

These objectives relate to the requirements for development and use of telecommunications technology both as a delivery tool for instructional support and as a teaching tool within the Instructional Resources System.

Similarly, the study rests upon a number of key assumptions, some of which are purely educational in nature, and some of which go beyond the province of education to encompass aspects of society as a whole. In planning, or in planning to plan, which is the nature of context analysis, such assumptions about major events provide an essential basis for subsequent thinking. Assumptions, as indicated, may relate to the world at large or to a particular area of investigation, but they all involve potential developments that cannot be predicted with complete accuracy and that therefore are beyond control. Basic assumptions of this Texas Educational Telecommunications Study (not stated in any particular order) are that:

(1) The flow of information of all kinds will continue to increase dramatically worldwide, as will the capability to store and to communicate this information, and knowledge which has heretofore been the province of specialists will become more generally accessible;

(2) The ongoing reaction to the traditional Protestant work ethic and the competition it engenders will continue, at least for a time, and there will be an increased pluralism of life views and values;

(3) Society will become more open to innovation, more oriented toward the individual, and more insistent on his/her involvement and participation, although resistance to change will continue to exist;

(4) There will be a continuing increase in available technology, and more coordination of technological efforts throughout society;

(5) Education will be viewed increasingly as a lifelong process, and as a more continuous process, with fewer clearly defined "cutoffs" (graduations, degrees, etc.);

(6) Education will become both more accessible and more relevant to learners, with greater individualization and more special provisions for educationally diverse learners;

(7) Education will become more informal as it becomes more accessible, and will be more and more interrelated with vocational training and with work itself;

(8) Educational concepts, curricula, instructional strategies, the learning environment, and the role of the teacher will steadily continue to change;

(9) The educational system will become increasingly dependent on supporting information systems to provide instructional materials, teaching aids, and means of information processing.

The information upon which these assumptions are based, and which this study has sought to assimilate, organize, interpret, and use to arrive at its ultimate recommendations, has come from intensive research in the fields of education, telecommunications technology, and futures prognostication. In addition to using the formal research channels available locally through the University of Texas and Texas Education Agency, the Educational Development Corporation has corresponded with telecommunications planners in other states and at the federal level, and has used the extensive network of professional contacts generated by the various specializations of the staff members to elicit the most recent information available on both innovative technology and creative thinking.

Finally, it is necessary to emphasize at this point the fact that it takes any sizable innovation--educational, technological, or other--some eight to ten years to be fully installed and operational. Furthermore, for economic amortization, an innovation should have a subsequent employment of another seven to ten years before becoming obsolete or being superseded by some further innovation. Thus, the most significant time frame under consideration in this study, as will become more apparent in the following sections of the report, is a period spanning from fifteen to twenty years in the future.

In addition to this overview, the report of the Texas Educational Telecommunications Study includes:

(1) A discussion of the critical factors which would have to be taken into consideration in conceptualizing or planning for a statewide educational telecommunications system, and a delineation of the specific criteria derived from consideration of these factors;

(2) A survey of the perceived needs for educational telecommunications throughout the state;

(3) An examination of existing telecommunications techniques and capabilities in Texas, together with an exploration of their utilization;

(4) A review of the current status of telecommunications systems, existing or planned, in other states;

(5) A study of available software which can be adapted to existing technology, plus a projection of the future of educational software and a discussion of potential compatibilities;

(6) An analysis of ongoing trends in both technology and education, and an array of forecasts for the future, not necessarily based on these trends;

(7) An exploration of alternative methodologies for meeting these needs, based on existing or forthcoming technology and software, and projections for the future;

(8) Findings as to the different expectations concerning these alternatives and conclusions based on their respective merits, including discussion of possible ownership, policy, and control structures;

(9) Recommendations for broad future actions, based on the findings and conclusions.

Given the findings, conclusions, and recommendations of this report, the Texas Education Agency should be able to determine the telecommunications requirements for the Technology and Dissemination Program, and to begin to make plans for meeting these requirements.

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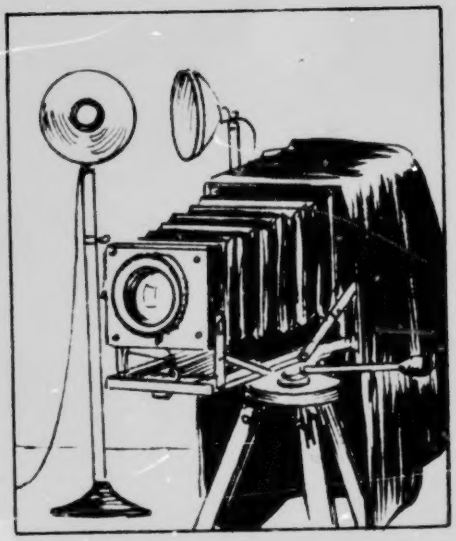
III

criteria



PRÉCIS

With the objectives and purposes of this study set, and the parameters laid out in the scope, it is next necessary to establish standards, or criteria. This chapter identifies the various elements and factors that should be considered, and suggests a criterion for each one. These criteria will be used later in the study for purposes of assessment.

The opening discussion covers many facets of the use of criteria. The factors and criteria are divided into six main areas: abstract (study criteria), technological, political, organizational, strategic, and financial. Each criterion also falls into one or two of three separate categories: those used to guide the study, those used in conducting assessments, and those which may be used in later phases of work.

Following this discussion, for ready access, is a listing of all the criteria, without further discussion. There are 25 criteria, listed according to the six groups previously mentioned and not in any order of importance.

Next, under the heading "Factors," the same considerations are presented, with a full discussion of each one followed by the criterion derived from it. The chapter closes with a transition leading into the next portion of the study.

It should be noted that 11 of the criteria in this chapter are not appropriate for later use in the study; the 14 which are used are identified in Chapter IX. Further, although the criteria are not weighted here in terms of importance, they are given such weightings in Chapter IX, which process is also explained here.

Chapter contents are:

Concepts p. III-1
Criteria p. III-2
Factors p. III-4
Transition p. III-13
Bibliography p. III-13

III

FACTORS AND CRITERIA

CONCEPTS

This section of the report sets out to provide a synthesis of all the thinking and rationale used in this study, which process has enabled us to state certain conclusions and make certain recommendations, but it is by no means an exhaustive accounting of such thinking. No one document could adequately cover all the ramifications of the research and analysis that have brought us to this present point. However, an understanding of the fundamental thought processes involved is essential to any appreciation and/or acceptance of the conclusions presented later in the report. To this end, we offer brief synopses of the various factors which have been taken into account in the gradual development of our conclusions and recommendations. These factors are not discrete or mutually exclusive considerations; in fact, they overlap and impinge upon one another to a degree that makes it difficult to consider them as separate entities, although we must necessarily describe them as such here.

In weighing the various factors and examining their respective impacts on potential solutions or solution strategies, we have thought largely in terms of the constraints that would necessarily be imposed on any conceivable solution. Some of these constraints, such as time and costs, are implicit within the discussion of specific factors; others compelling particular kinds of thinking or activities, such as the plethora of extremely small school districts in the state of Texas, are a consideration underlying and interacting with all the factors. All of them have weighed heavily in our decision-making, for any one of them could negate the success of almost any solution strategy, were suitable allowances not made.

In compiling this discussion of the factors affecting our final recommendations, we have grouped the factors into rather general categories to emphasize the broad outlines of the underlying thought. Each factor is given a brief narrative discussion, and each is directed toward the formulation of a specific criterion for the development of any solution strategy.

Any solution under consideration must necessarily be a compromise; no one solution is perfect. How, then, do we weight the various criteria, and what is their relative importance? This subject constitutes a study in itself, and the criteria will rearrange themselves as seen through the eyes of each district. The most reasonable approach, then, was to examine each criterion as it fit into one of two categories.

Some criteria are mandatory, or virtually so; others are optional, and the recommendations of this report are those which, in our opinion, meet the majority of the most significant criteria most fully.

The criteria, like the factors, are here divided into six general groups: abstract, technological, political, organizational, strategic, and financial; they are not placed in any order of priority until later in the report. Most of the criteria in the last four groups are weighted further on in the report, necessarily somewhat subjectively, and used on the matrices in Chapter IX, "Alternative Solutions," by means of which the merits of the various technologies are ultimately assessed. We found that the criteria fall into three categories: (1) those used to guide this study; (2) those used to make findings and recommendations; and (3) those which should be applied after this study, if implementation of its recommendations occurs. (A few criteria fall into both category (2) and category (3).) However, all these criteria are kept under consideration throughout the study, and all play some part in the final determination of optimal solution strategies. Although this runs contrary to the logical order of development, we have cited the criteria first for the sake of convenience; this listing is then followed by a fuller discussion of the thinking involved in the establishment of each criterion.

CRITERIA

Recommendations and suggested solution strategies resulting from this study:

Abstract

(a) Should result logically from the systematic analysis of the problem of delineating statewide needs for educational technology and telecommunications.

(b) Should suggest definitive steps toward meeting specific educational needs identified by the Texas educational community through written or verbal input to the study, as well as by educators nationwide.

(c) Should be related to Texas' educational goals and should include a description of the kinds of specific instructional objectives that will need to be determined before further innovative technology is introduced into Texas classrooms; no further planning or work effort should be undertaken without provision for the development of such objectives.

(d) Should be made on the basis of the latest research and best knowledge currently available, should be sufficiently flexible to permit adaptation as new educational discoveries are made, and should provide for tailoring different mixtures to different situations.

Technological

(1a) Should include some consideration of how this technology can best be coordinated and integrated with existing or planned technological methods, both at the local level and throughout the Instructional Resources System.

(1b) Should take into account the experience and the opinions of previous and present users concerning the technologies under study, and should be based on an analysis of varying combinations and conjunctions of these technologies.

(1c) Should ultimately be cost-effective in terms of new equipment required vs. educational benefits derived.

(1d) Should include a comprehensive consideration of software appropriate to their implementation.

(1e) Should include suggestions for the development of a comprehensive technological maintenance system, and for the operation of such a system.

(1f) Should include suggestions for minimizing the effects of gradual obsolescence both of individual components and of the entire system.

(1g) Should include suggestions for pre-service and in-service training in conceptualizing, planning, using, and maximizing the new technologies, and for an overall system for carrying out this training.

(1h) Should make adequate provision for individualization of instruction, while providing interaction and permitting group discussion where appropriate.

Political

(2a) Should show sensitivity to the objectives and the capabilities of various political entities in the state, such as vendors' lobbies or teachers' groups, so that any ultimate implementation may be politically feasible.

(2b) Should include suggestions regarding the ultimate authority on curriculum and scheduling control, and this authority should be determined in the course of any subsequent planning effort. Solutions should include consideration of scheduling and timing, related to each student.

(2c) Should include provision for evaluation of the effectiveness of the new technology, and some comprehensive suggestions should be made for establishing and maintaining communications throughout the whole process of introducing technological innovations into the Texas public schools.

Organizational

(3a) Should include considerations of existing facilities and compatibility, and suggestions for coordination of operation with other present or potential users of the technologies in question, where appropriate.

(3b) Should include suggestions for a comprehensive organizational and administrative capability to implement the use of new technology in the Texas public schools.

Strategic

(4a) Should include suggestions for initiating planning activities, together with comments concerning the various functions to be planned. Such planning should include all possible aspects of inducing change.

(4b) Should include some provision for dissemination of information on all elements of the new program of educational technology.

(4c) Should include some suggestions for presenting them in a positive way that will be both encouraging and stimulating to those who must implement them in the schools; final selection of strategies should involve input from, and participation by, their eventual users.

Financial

(5a) Should include an estimate, both financial and spatial, of supply requirements associated with them.

(5b) Should include a consideration of the types and numbers of support personnel that are likely to be needed, as well as suggestions for the employment, training, and utilization of these persons, and for their integration into the existing educational structure.

(5c) Should include careful cost estimates, along with suggestions for sources and methods of funding to meet these costs.

(5d) Should be shown, through cost-benefit analysis, to be both educationally sound and economically viable, and to be preferable to other strategies in those situations for which they are intended.

(5e) Should be developed on the basis of careful consideration of the time and trouble the technologies may ultimately cost schools to implement, and should include subsidiary recommendations on how to lessen or neutralize these costs as much as possible.

FACTORS

Abstract

(a) Systematic Analysis of the Problem. In determining the kinds of factors which must be considered in the study, conceptualization, or planning of educational technology and telecommunications, without a doubt the most logical and inclusive methodology is the use of the "systems approach." Initially, it is essential to understand the implications of this method. We may define system here as "...a confluence of interacting elements that carry out a pre-determined function, cooperatively, and in such a way that the relationships of the elements to each other and to the whole are clear." (Higginson, Swanson, and Love, 1969) Systems may be either closed or open; an open system is one which can only exist through continuing communication with, and reception of feedback from, its environment. The Texas educational system is such a system, dedicated to the facilitation of learning through the provision, as appropriate, of particular kinds of materials, teaching strategies, and technology.

In this study, we have not only examined the teaching/learning system of the state of Texas, but also have used an overall systems approach to pursue our investigation. Basically, such an approach entails determining needs; identifying some of these needs as priorities; establishing goals on the basis of the priorities; defining specific objectives whose respective attainment will eventually result in reaching the goals; identifying the various constraints which may work against the attainment of the objectives; generating alternative solutions for their attainment; selecting the most promising alternatives for implementation; implementing these alternatives; evaluating the extent to which the objectives have been reached; and revising implementation activities on the basis of evaluative feedback.

In taking this kind of approach, it is necessary to take into account all the elements of a given system, as well as their various interrelationships. Any action taken to affect one specific element usually turns out to affect others as well, or to alter the nature of the relationships between them. Similarly, an action taken in one area may clearly and obviously demand a series of concurrent or consecutive actions through the system in order to keep it functioning smoothly and effectively. Thus, all the persons who would be involved in the implementation of new educational technology--students, teachers, administrators, parents, technicians, and others--would have to be considered in terms of their initial and continuing needs for orientation, training, and preparation. Hardware and software would have to be examined in terms of instructional effectiveness and cost-benefit. Equipment needs, possible linkage configurations, and maintenance requirements would all have to be studied. Provisions for dissemination of information on the innovations and their functioning would have to be made, as would arrangements to expedite communications between educators and ensure a continuing flow of feedback to those persons who will have to make key decisions on various functions. Clearcut objectives would have to be established, along with procedures for evaluation of their attainment. Even though all these activities must occur in proper sequence during implementation, they must be considered simultaneously during analysis, and their impacts and impingements on each other examined or extrapolated. Just as these, and other, considerations would have to be undertaken simultaneously in planning for and installing innovative technology to meet educational needs throughout Texas, so must they be treated simultaneously in determining the needs for, or feasibility of, any systematic application of this technology. All factors discussed in this section, therefore, must be viewed as inextricably related or interrelated, and as contributory to the functioning of a total, vital, and open system.

CRITERION: Recommendations and suggested solution strategies resulting from this study should result logically from the systematic analysis of the problem of delineating statewide needs for educational technology and telecommunications.

(b) Meeting of Needs. It is essential to keep in mind that the entire Texas Educational Telecommunications Study is basically a context analysis, or needs assessment. Educational needs assessment, according to one source, entails "...formal attempts to determine what should be done and learned in schools. Needs assessment procedures are keyed to the concept that relevancy of education must be a consensus of all parties concerned and determined by a formal procedure, which precedes educational planning, design, and implementation." (Sandmann and Casey, 1971) Further, needs assessment is the first step in a systems approach to any problem, and as such, this study constitutes a vital prerequisite to any planning or implementation activities which may subsequently take place in educational telecommunications. Thus, it should be emphasized that the study has sought to determine, without preconception or bias, what educators in Texas perceive as basic requirements for improvement of the teaching/learning process and what sociologists, nationwide, see as broad educational needs, and only then to look at available technologies to see which may best meet these needs. Solutions should be tailored to real problems, and not be ends in themselves for which problems must be located or invented.

CRITERION: Recommendations and suggested solution strategies resulting from this study should suggest definitive steps toward meeting specific educational needs identified by the Texas educational community through written or verbal input to the study, as well as by educators nationwide.

(c) Development of Goals and Objectives. Some overall goals have been established for education in Texas, and it must be assumed that each district has already developed policies, procedures, and programs toward these ends. However, introduction of innovative technology into the Texas educational system requires not only an understanding of what this technology is potentially capable of doing, but also a delineation of the specific objectives it can reasonably be expected to accomplish. Anticipated improvements in learning are, for the most part, measurable in behavioral terms, and should be set forth accordingly. Determination of educational objectives with this degree of specificity will require the agreement of both the policy-makers within the educational system, who will issue these objectives, and the school personnel who will actually work toward their attainment in the classroom. To this end, a series of conferences on instructional objectives should be held prior to or concurrent with the initiation of any planning effort that may follow the study.

CRITERION: Recommendations and suggested solution strategies resulting from this study should be related to Texas' educational goals and should include a description of the kinds of specific instructional objectives that will need to be determined before further innovative technology is introduced into Texas classrooms; no further planning or work effort should be undertaken without provision for the development of such objectives.

(d) Broad Research Base. To meet any given educational need, there will be a variety of alternative solutions. Some of these solutions may involve telecommunications technology, while others may not, and the telecommunications solutions themselves will differ widely in both cost and impact. The educational field in general lacks sufficient hard data on the cost-effectiveness of various instructional technologies and techniques, and telecommunications use in particular is new and comparatively undocumented. Continuing study must be made of the effectiveness of various media, and media combinations, in differing educational situations (e.g., large group, small group, individual), presenting different kinds of content (e.g., subject areas, enrichment vs. fundamentals), and presented to different audiences (e.g., learners from various socio-economic, cultural, ethnic, and linguistic backgrounds). Research should also continue on the potential of these media for providing creative and unusual presentations, on their respective flexibility within the present or projected learning environment, and on the strength of their appeal to the learner, so that more and more informed choices can be made whenever it is necessary for a teacher, a school, a district, or a state agency to select educational solution strategies.

It must also be borne in mind that no one solution strategy can provide a final answer; that in most cases a combination of several strategies will be most desirable; and that this combination will vary, probably tremendously, from situation to situation.

CRITERION: Recommendations and suggested solution strategies resulting from this study should be made on the basis of the latest research and best knowledge currently available, should be sufficiently flexible to permit adaptation as new educational discoveries are made, and should provide for tailoring different mixtures to different situations.

Technological

(1a) Integration of Technology. If innovative technology is to be introduced into the Texas public schools and coordinated with existing technology, a thorough knowledge of what presently exists is essential. For example, according to the latest information available from the Texas Education Agency, only about 10 percent of Texas school districts have closed circuit TV systems. Lack of such a system would obviously limit the kinds of software a district could use, as would the lack of various other kinds of receptors. Furthermore, if the use of such technology is considered on a statewide or regional basis, other kinds of considerations will also be critical. Current and projected use of the 2500-2690 MHz band must be considered and coordinated with other telecommunications activities; specific requirements for additional coverage, to provide adequate signal strength to areas of population concentration, must be determined; and optimum available channels for statewide use would have to be ascertained, along with any necessity for activating new channels and the time and costs required. Ultimately, it might be desirable to consider developing one network to cover the entire state, and, in that case, specific configuration of the network (closed-loop or spoke system, individual campuses to be involved, etc.) would have to be determined.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include some consideration of how this technology can best be coordinated and integrated with existing or planned technological methods, both at the local level and throughout the Instructional Resources System.

(1b) Overall Coordination. Some comprehensive telecommunications systems are already employed in other states and regions, both in education and in other fields. In determining the most feasible actions for Texas to take with regard to telecommunications technology and the public schools, it is necessary to examine these existing networks, to study the factors that went into their development, and to judge their comparative success or viability at this point in time. To this end, the Texas Educational Telecommunications Study has requested from other states information on the status of existing or planned telecommunications systems, has done extensive research on such systems, and has undertaken visits to the sites of ongoing efforts in telecommunications, such as the Association for Educational Communications and Technology, the National Association of Educational Broadcasters, the Joint Committee on Electronic Telecommunications, the Federation of Rocky Mountain States, the Stanford Research Institute, the RAND Corporation, the Annenberg School of Communications at U.C.L.A., and others. The information thus gleaned from the varied experience of others with similar interests and objectives is not only valuable but essential to decision makers in determining the utility of telecommunications technology in public education in Texas.

CRITERION: Recommendations and suggested solution strategies resulting from this study should take into account the experience and the opinions of previous and present users concerning the technologies under study, and should be based on analysis of varying combinations and conjunctions of these technologies.

(1c) Cost-Effectiveness of New Technology. New educational technology frequently requires the use of extensive and costly equipment, and this fact must be taken into consideration in any statewide planning effort for instructional resources. Some media, such as instructional radio or even video cassette systems, may be no great trouble or expense to install in schools, but the initiation of satellite broadcasting, for example, would be a tremendously expensive and involved process in terms of providing equipment and facilities. Therefore, in establishing the cost-effectiveness of a given technology and feasibility of implementing it in Texas schools within the next few years, the hardware associated with each type of technology must be determined and studied in some detail.

CRITERION: Recommendations and suggested solution strategies resulting from this study should ultimately be cost-effective in terms of new equipment required vs. educational benefits derived.

(1d) Availability of Software. Any widespread use of educational technology in the public schools of Texas will pose an enormous requirement for software (the various content-carrying materials used with technological instruments, such as filmstrips, video tapes, and computer lessons); otherwise, expensive hardware might lie idle or under-used. Some good software for primary and secondary education is now available, but may be difficult or costly to obtain, and the problems presented by copyright regulations may be considerable. There are also areas, such as computer-assisted instruction, where there is a dearth of software. Whether software is purchased from commercial firms, obtained via local stations or organizations, or generated within the schools themselves, it must be carefully examined and evaluated to ensure that it is compatible with broad instructional objectives and with the aims of the particular course of study into which it will be integrated. Additionally, given the rapid pace of social change, software of all kinds obsolesces quite rapidly--usually in three to five years. Thus, replacement costs must be considered.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include a comprehensive consideration of software appropriate to their implementation.

(1e) Feasibility of Maintenance. The use of increasingly sophisticated educational technology brings with it increasingly complex problems of maintenance, and statewide use of such technology in Texas schools would necessitate a complete maintenance program, which could be both costly and time-consuming in the planning and implementation. Minor maintenance tasks might be carried out by teachers, which would necessitate a certain amount of advance training in equipment use and repair. Slightly more complicated tasks could be handled by giving some person in the school district major responsibility for overseeing the new technology, but an overall maintenance program would also be likely to include procuring test and maintenance equipment; conducting regular tests of the technology system to make sure everything is functioning optimally; and scheduling periodic maintenance for equipment and facilities throughout the state. It might also include employment of a statewide maintenance supervisor, with subordinate maintenance workers responding to this person in a technical capacity. Spare parts and components would have to be stocked in sufficient quantity, considering common and specialized aspects; low and high cost components; and components with a predictable life span, together with those subject to sudden and catastrophic failure. All these considerations should be included in the development of a comprehensive technological maintenance system, which would become operational if and when any large amount of innovative technology were introduced into the schools.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include suggestions for the development of a comprehensive technological maintenance system, and for the operation of such a system.

(1f) Avoidance of Obsolescence. In introducing any major new system on a widespread basis, a major factor to consider is that of its eventual obsolescence. In some cases, the entire system may be supplanted by an innovation whose effectiveness and/or efficiency have become significantly greater. More often, particular components of the system--hardware, software, training activities, or whatever--will wear out or become outdated. Lest the former situation occur, it is well not to plan a system so radical, so complicated, or so inflexible that it cannot interact in a variety of modes with those existing systems which it supplants or joins, as well as with those which may come after it. In the latter instance, advance planning must take into account the eventual need for replacement of various components, and provisions must be made for carrying this out with minimal interruption of system functioning.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include suggestions for minimizing the effects of gradual obsolescence both of individual components and of the entire system.

(1g) Training to Use the Technology. Training for both teachers and administrators in the use of new technology is essential if this technology is to be successfully implemented in the Texas public schools. At present, there is not enough relevant pre-service and in-service training for school personnel in the instructional application of technology, and there are not enough utilization specialists to assist local schools on a statewide basis. Extensive use of innovative technology would necessitate a massive training effort, including preparation (textbook assignments, reference readings, lists of new terms, etc.), viewing of the technology, and follow-up (discussion, evaluation, summary), and this program would have to be designed, refined, and implemented prior to and during the introduction of the innovations. Requirements for in-service training would also have to be delineated, and a comprehensive program set up and monitored continuously by the authority ultimately responsible for use of the technology. Much of the overall training effort should be carried out by means of this same technology, so that its characteristics and potential utility are manifest to future users.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include suggestions for pre-service and in-service training in conceptualizing, planning, using, and maximizing the new technologies, and for an overall system for carrying out this training.

(1h) Allowance for Individualization. Individualization of instruction, with its recognition that all learners do not learn at the same speed nor in the same way, is being viewed as an increasingly desirable improvement within the structure of public education. Advanced technology has great potential for furthering the development of individualized instruction; for example, computer-managed diagnosis and computer-assisted instruction can allow a student to work on specific problem areas at his/her own best rate of absorption and comprehension. However, technology used indiscriminately can also mitigate against individualization, as when thirty students watch the same classroom television program with no remedial explanation to those for whom the lesson is too complicated and no supplemental stimulation to those for whom it is too simple and boring. Furthermore, some learners may tend to view computers or television receivers as depersonalizing because of the lack of human contact afforded. Care must be taken, in the application of innovative educational technology, to ensure that both materials and instructional methodology can be tailored to the needs of the individual learner, and provided in the kinds of combinations and balances that he/she will find most personally satisfactory and conducive to learning.

CRITERION: Recommendations and suggested solution strategies resulting from this study should make adequate provision for individualization of instruction, while providing interaction and permitting group discussion where appropriate.

Political

(2a) Overall Political Feasibility. Throughout the country and within each individual state, the introduction of any kind of innovation will necessarily be affected both by the overall political climate at the time and by the objectives and the activities of a number of interest groups. In education, the interest of the current presidential administration in funding national educational programs, and the level of such funding, must be considered, as must the amount of money that the state is able and willing to spend on education. Specific technologies must be examined in terms of the power that their propopents are able to wield; for example, the almost absolute authority of the Bell Company in matters of telephony is certainly a force to be considered, and so is the authority of some of the larger publishing companies when the question of textbook adoption comes up. With regard to radio and television, sprawling cable conglomerates or powerful local interests may hold virtual monopolies in some areas. The new Utility Commission of Texas, with policies as yet not delineated, must be considered. Finally, the political interests and strengths of the potential users themselves must be considered. Teacher resistance to a given technology can completely negate its possible effectiveness both within the classroom on a day-to-day basis and on a broader scale throughout the state, and user needs, preferences, and psychology should be carefully considered before attempting to introduce any innovation.

CRITERION: Recommendations and suggested solution strategies resulting from this study should show sensitivity to the objectives and the capabilities of various political entities in the state, such as vendors' lobbies or teachers' groups, so that any ultimate implementation may be politically feasible.

(2b) Provision for Curriculum Control. The overall question of curriculum control is a significant one in considering the introduction of innovative educational technology into an existing curriculum. Decisions must be made regarding the authority to determine what technology will and will not be used in the public schools of the state, to decide upon the nature and scope of the substantive content which will be presented via this technology, and to oversee its use on a continuing basis. Responsibility for scheduling this use must also be determined; for example, who decides when a particular television program will be broadcast into the classrooms, and on what basis? Teachers may find it difficult to organize other necessary class activities around a fixed-time broadcast, or to arrange a syllabus so that a particular program can be viewed at the time when it is most relevant to course content. Handling problems and questions of this nature will be difficult and time-consuming; possible alternatives should be explored, and responsibility for the tasks determined prior to introducing the technology, in order to expedite solution or resolution.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include suggestions regarding the ultimate authority on curriculum and scheduling control, and this authority should be determined in the course of any subsequent planning effort. Solutions should include consideration of scheduling and timing, related to each student.

(2c) Provision for Evaluation and Communication. Introduction of new technology into a state school system is not a simple process, and requires continuing assessment, evaluation, and re-evaluation in order to be successful. To this end, it will be necessary to devise a system for evaluation of the effectiveness of new hardware, software, and procedures employed by school personnel in their use. Such evaluation will be complex, and must be carefully planned before the technology is ever introduced into the schools, so that assessment can begin simultaneously with use, and so that pre-existing conditions can be noted as baseline date. Provisions must also be made for continuing communication between the school personnel using the innovations and the authorities involved in their introduction, so that any problems can be quickly ascertained and efforts made to resolve them as rapidly as possible. Many revisions will undoubtedly be necessary in developing a smoothly functioning system of sophisticated educational technology, and some solution strategies may prove completely ineffective in particular situations and have to be abandoned altogether.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include provision for evaluation of the effectiveness of the new technology, and some comprehensive suggestions should be made for establishing and maintaining communications throughout the whole process of introducing technological innovations into the Texas public schools.

Organizational

(3a) Overall Coordination. Initiating any major effort in the introduction of innovative educational technology into Texas schools would require extensive and complete coordination of the component activities, both with one another and with ongoing activities involving similar technology throughout the state. Potential participants in a complete system of telecommunications technology, including non-educational users, should be identified, and efforts made to establish communications between them if none presently exist. Relationships between the Texas schools and other possible user organizations should be developed or strengthened, for statewide utilization of new technologies will be much more economically feasible if there are a larger number of agencies and organizations involved. In undertaking this coordination effort, special attention should be given to present and optimal availability of television channels, audio resources, and cable space, to the compatibility of existing technological resources, and to the commercial stations and state microwave towers which might be suitable for, and amenable to, additional use and sharing of space and personnel. Attention should also be given to determining the authority, responsibility, priorities, and rights of potential users of a coordinated system with regard to both its functions and its tangible components. Further, if such a complex system were to be developed, it would require mechanisms which would ensure its continuing responsiveness to all the needs of its various users, and thus its continuing durability.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include considerations of existing facilities and compatibility, and suggestions for coordination of operation with other present or potential users of the technologies in question, where appropriate.

(3b) Administrative Capability. Any extensive use of innovative technology in the state's public schools will require specific guidelines for administration. A central authority to manage the use of this technology may be required and the relationship between this authority and the user schools must be clearly defined in terms of guidelines for requesting programs and materials, provision of necessary technical information, etc. Overall responsibility for technical problems must also be allocated, so that these problems can be attended to rapidly and efficiently as they arise. Within districts, present responsibility for telecommunications and other sophisticated technology must be determined, as must the effectiveness of this particular allocation, so that changes can be made if necessary. Care should be taken to see that existing administrative structures, such as those of Library Learning Resource Centers, are used to best advantage, with new configurations or new responsibilities added as appropriate.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include suggestions for a comprehensive organizational and administrative capability to implement the use of new technology in the Texas public schools.

Strategic

(4a) Planning and Change. Extensive and intensive planning must precede the use of any new educational technology in the public schools of Texas. Such planning must encompass funding of new programs; recruitment of additional personnel as necessary; orientation and training of these persons and of persons already working in the state school system; purchase and installation of equipment; purchase of needed supplies; purchase and/or development of appropriate software; provision of suitable facilities where none presently exist; maintenance of equipment and facilities; scheduling of new programs and coordination of these programs with existing school activities; administration of new technological systems; facilitation of the use of new technologies, materials, and programs and promotion of their acceptance; evaluation of the effectiveness of these various innovations; and any other considerations connected with their introduction and implementation on a broad scale. It cannot be emphasized too strongly that these planning efforts must be initiated as soon as solution strategies have been selected or determined. And it must be emphasized also that careful and specific plans for coping with resistance to change are probably the most important facet of such planning.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include suggestions for initiating planning activities, together with comments concerning the various functions to be planned. Such planning should include all possible aspects of inducing change.

(4b) Dissemination Provisions. Widespread use of innovative educational technology in the Texas public schools will require an equally widespread dissemination effort to ensure that communities as a whole are fully cognizant of, and amenable to, the new kinds of activities going on in their schools. If this effort is not undertaken, community resistance to that which is unknown and potentially threatening may well undermine the success of the entire technological program. In preparing dissemination materials, it is advisable to use some of the same technologies that are being publicized, so that viewers or recipients of the publicity materials can understand and appreciate the nature and the benefits of these technologies. This approach will also allow those disseminating the information to display the various technologies to their best advantage, as they are meant to be used in appropriate and nurturant situations. The magnitude of this dissemination effort, which should be mounted well in advance of the time determined for introduction of the new technology into the schools, will be considerable, and its cost both in dollars and in time required for planning should not be underestimated.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include some provision for dissemination of information on all elements of the new program of educational technology.

(4c) User Input. Full acceptance of any innovation is a long, difficult, and complex process. People are naturally resistant to changes in long-established ways of doing things, and even when an innovation is successfully instigated, it usually takes up to ten years for it to become fully operational. To facilitate this process, opinion leaders who will be using technological innovations in the Texas public schools should be involved in the decision-making preceding their selection and implementation. Further, attention should be given to the problem of motivating all users of the innovations both before they are installed and during the installation process, so that their potential success will not be limited by negative or indifferent attitudes within the schools. Technology, in particular, may threaten a teacher with apparent loss of classroom control or of status with children, and care should be taken to present the innovations in a manner which does not intimidate as well as to instruct teachers carefully in their effective use. If initial usage then proves pleasant, comfortable, and successful, teachers will exert their efforts on behalf of the innovations rather than in opposition to them.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include some suggestions for presenting them in a positive way that will be both encouraging and stimulating to those who must implement them in the schools; final selection of strategies should involve input from, and participation by, their eventual users.

Financial

(5a) Supply Requirements. In addition to new hardware and software, the introduction of a broad range of educational technology into Texas schools is likely to require a new and more extensive inventory of supplies. Audio and video tapes, for example, are basically expendable items, yet comparatively high-cost. They also require a considerable amount of space to store. Each type of technology under consideration, therefore, should be examined carefully in terms of its supply requirements and the ways in which they will affect both the budget and the facilities of the schools implementing the technology.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include an estimate, both financial and spatial, of supply requirements associated with them.

(5b) Requirements for Support Personnel. An increase in the use of technology in the Texas public schools may pose a requirement for various kinds of support personnel not now employed within the state school system. For example, audiovisual specialists, persons with computer expertise, and possibly maintenance personnel may need to be added to a school and/or district staff in order for the new technology to function effectively. The source of funds to pay any of these additional salaries will have to be determined; whatever training or orientation is deemed necessary or desirable for these persons (and for others already on board) will have to be planned; and coordination of their roles and activities with those of existing school personnel will have to be achieved. These considerations must come early in the planning effort for any extensive introduction of new technology into the schools, so that the necessary expertise can be available and ready to function efficiently when it is needed.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include a consideration of the types and numbers of support personnel that are likely to be needed, as well as suggestions for the employment, training, and utilization of these persons, and for their integration into the existing educational structure.

(5c) Suggestions for Funding. Extensive use of new technology in Texas public schools may require a level of funding not presently available, and possible sources for such funding should be explored in advance. New federal or state appropriations may constitute an important source, but until or unless such legislation can be enacted, other possibilities must be carefully examined. Determination should be made of the percentage of the increased costs associated with innovative technology that the schools themselves would be able to bear, or that communities would be willing to pay in the form of taxes or bond issues. If funding is to be fragmented, as it most likely will be, then highly systematic budgeting methods will have to be worked out in order to avoid confusion and failure. Needless to say, the actual costs of recommended or plausible configurations of educational technology for statewide use must be reckoned as accurately as possible before the various ways of meeting these costs can be fully explored. Additionally, consideration should be given to long-term funding possibilities, which may affect initial decisions concerning ownership, leasing, joint endeavor, and other amortization choices.

CRITERION: Recommendations and suggested solution strategies resulting from this study should include careful cost estimates, along with suggestions for sources and methods of funding to meet these costs.

(5d) Overall Cost-Benefit. Any type of educational technology, whether compared to other instructional strategies or judged strictly on its own merits, will have to be examined in terms of cost-benefit before being introduced on a large-scale basis into the public schools. Costs of innovative technology include the obvious ones of procurement of new equipment, software, and materials; configuration of facilities; installation of equipment and its connection, if necessary, with previously existing systems; maintenance and repair of the equipment; provision, replacement, and upgrading of supplies; training in the proper use of the technology for teachers and other personnel; and hiring of any supplementary personnel who may be required for successful implementation of the technology. There may also be hidden costs, manifested in the need to devote time to the innovation that might be more efficiently allocated to something else in the daily school schedule, and there may be hidden savings in the diminishing of time requirements or requirements for certain materials. Overall benefits derived from new educational technology relate, of course, to measurable increases in learning and to extent of saturation of the target population; thus any proposed innovation should be carefully tested and compared in both effectiveness and cost with other methods for achieving the same kinds of increases on the same scale, so that significant advances can be made without undue expenditure.

CRITERION: Recommendations and suggested solution strategies resulting from this study should be shown, through cost-benefit analysis, to be both educationally sound and economically viable, and to be preferable to other strategies in those situations for which they are intended.

(5e) Continuing Implementation Costs. One major problem inherent in the use of innovative educational materials, equipment, and techniques is that it is often difficult to fit them into existing classroom schedules, especially in the case of rigidly scheduled broadcasts of television programs or pre-allocated computer time. If it is difficult or inconvenient to work something new into an already crowded schedule, teachers and administrators are likely to let the innovation languish unused, or, at best, under-used. Furthermore, new technology may require that additional time be spent by school personnel in planning, preparation, equipment handling and maintenance, and follow-up activities, any or all of which may be perceived as an excessive burden. This, again, works to the detriment of the innovation in question. Any technology being considered for classroom use should, therefore, be studied in terms of the additional time its use may require, and careful scheduling, with the participation of all involved, should precede its introduction into the classroom. It may also be appropriate to assess whether such time can be obtained by eliminating some specific tasks associated with the new technology, or whether more school staff will be required.

CRITERION: Recommendations and suggested solution strategies resulting from this study should be developed on the basis of careful consideration of the time and trouble the technologies may ultimately cost schools to implement, and should include subsidiary recommendations on how to lessen or neutralize these costs as much as possible.

TRANSITION

Thus far, development of this report has been in more or less sequential order of thought. Now, however, it is time to look at a number of considerations simultaneously, although they must necessarily be presented sequentially for narrative purposes. As indicated in the Introduction in Figure I-A, the chapters entitled "Needs Survey," "Existing Telecommunications Networks in Texas," "Telecommunications Activities in Other States," and "Software" represent examinations of discrete but interconnected subjects which evolved in essentially the same time period and must be read with this in mind; thus, these chapters may be read in any order. The chapter on "Futures" was written along with the preceding chapters, but the subject matter by its very nature necessitates a different chronological frame of reference. Finally, all these various considerations, taken together, are examined in terms of the basic objectives of all educational technology and of the specific criteria just delineated in order to posit alternative solutions and arrive at conclusions and recommendations in the chapters thus named.

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SUGGESTED ADDITIONAL READING

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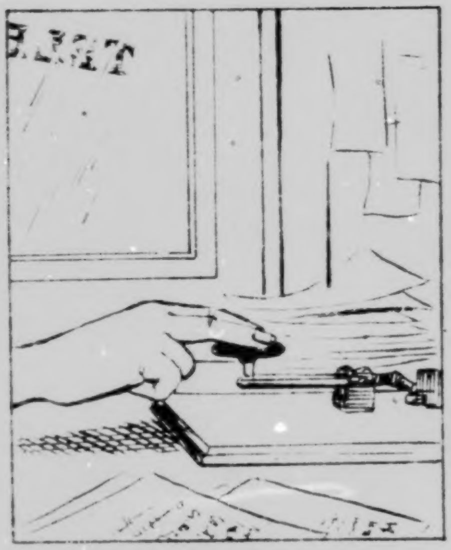
IV

needs



PRÉCIS

This portion of the report describes a statewide sampling survey to determine needs for and attitudes about educational technology. The survey itself focused on the identification of problems (particularly those that might be cleared up through the use of technology), rather than on the solicitation of solutions.

The discussion covers the nature of the survey, followed by the rationale for the sampling. The questionnaire and forms used are described in the text; copies appear in Appendix Alfa. Characteristics of the respondents are compiled, and some analysis of their attributes is presented.

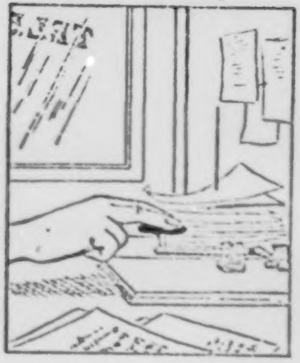
The major part of the chapter is devoted to a description and analysis of the responses to the questionnaire and the resultant findings. Summary tables are shown in the narrative; complete tabulations and statistical enumerations of the responses are included in Appendix Bravo.

The findings, in general, indicated that there is a strong need and desire for updating of information on both education and technology; this view is held more strongly by administrators than by teachers. Both groups are supportive of technology, although they are not very optimistic about its introduction on a large scale because of school board and parent attitudes.

Overall attitudes toward the use of technology to meet teacher needs were more positive than negative. The expression of need from both teachers and administrators for information and for continuing education was staggeringly high, and should be given high priority in any instructional resources system. There appears to be a general climate of acceptance, with some honest reservations, and a genuine desire on the part of professional personnel who responded to the survey to continue to learn.

Major sections of this chapter are:

Nature of the Study p. IV-1
Development of Sample and Rate of Response p. IV-2
Characteristics of Respondents p. IV-3
Findings from the Questionnaire p. IV-8
Information Supplied by Teachers Only p. IV-20
Information Supplied by Administrators Only p. IV-21
Summary Remarks p. IV-24
Bibliography p. IV-26
(See also Appendices Alfa and Bravo)



IV

TEXAS NEEDS SURVEY

This chapter summarizes the findings of the survey of professional personnel in the Texas school system concerning the potential usefulness of telecommunications technologies in improving the quality of education afforded pupils in Texas schools. Since this study as a whole seeks to suggest possible solutions for actual needs and problems in education throughout the state, rather than providing preconceived solutions where no need may exist, it was essential to determine the opinions of the educators themselves concerning their needs and the ways in which various technologies might be used to meet them.

NATURE OF THE STUDY

Prior to conducting the actual survey, a trial questionnaire was devised, along with a sheet for respondent comments. A sampling of 29 educators from the Central Texas area was contacted and asked to participate in a trial run of the questionnaire. This sample, comprised of 9 teachers and 20 administrators, included personnel from elementary schools, junior and senior high schools, the Texas Education Agency, the Austin Independent School District, the Region XIII Education Service Center, the University of Texas, and Texas A&M University. A total of 17 persons actually filled out and returned the questionnaire and comment sheet, and all but one or two of these responses were usable. On the basis of their overall comments, the structure of the questionnaire was simplified and its length was reduced through consolidation of a number of questions. In its revised form, the questionnaire then went out to those persons selected to participate in the final survey.

The small sample study of needs of educators with regard to telecommunications technologies included questions concerning problems, information needs, requirements for assistance in improving teaching, attitudes toward various technologies and their applications, and attitudes of administrators toward funding priorities.

Sample

Since the sample of educators queried was small, the results of this assessment must be interpreted with the limited number of respondents in mind. The low response rate from teachers is of particular concern, and caution is urged in extrapolating their answers to a much larger teacher population. However, educators from all parts of the state, in school districts of all sizes, in all levels of schools, and in all grade levels and subject areas were queried and responded.

Need for Information and Assistance in Teaching

Both teachers and administrators were queried concerning additional instruction and information which they viewed as desirable in enabling teachers to improve their performance. Administrators were also queried about special information needs which they might have in carrying out their planning and instructional leadership functions.

Attitudes Toward Educational Technology

A considerable part of the survey was devoted to an assessment of the attitudes of teachers and administrators in several areas of concern. Both groups of respondents were queried concerning their attitudes toward the subject and/or curriculum areas in which they felt educational technology (and by extension, telecommunications) might be most helpful. They were also queried about their attitudes to given technologies and their perceptions of the effects of such technologies on the educational system. Attitudes toward investment of local funds for support of telecommunications technologies and toward use of the technologies by teachers as a part of in-service programming were included.

Copies of the survey instruments appear in Appendix Alfa; additional discussion of the survey and the findings follows.

DEVELOPMENT OF SAMPLE AND RATE OF RESPONSE

The composition of the sample of Texas school personnel who received the needs survey questionnaire was determined in the following manner. Given a total public school ADM of 2,681,000 students for the state of Texas (Texas Education Agency, Annual Educational Statistical Report, 1972-73, 1974), the numbers and percentages of the students attending school in districts of specific sizes were ascertained. A complete breakdown of school population according to district size is given in the table below.

	Parameters of Size	Number of Districts of This Size	Number of Students in All Districts of This Size	Percentage of Total School Population in Districts of This Size
Size A	Under 500	537	128,000	5%
Size B	500-999	213	165,000	6
Size C	1,000-1,499	107	128,000	5
Size D	1,500-4,999	188	530,000	20
Size E	5,000-9,999	35	273,000	10
Size F	10,000-49,999	44	815,000	30
Size G	Over 50,000	6	643,000	24

Table IV-a

The total ADM was further divided out by grade, indicating that 70 percent of these students were elementary and junior high school students (grades K-8), 28 percent were in secondary school (grades 9-12), and two percent were in special education. Given a total sample size of 500, of whom 60 were to be Regional Education Service Center personnel (three from each of the 20 service centers) and 40 were to come from institutions of higher education (teacher training colleges) throughout the state, the remaining 400 questionnaires were allocated among the different sizes of school districts on the basis of percentage of total state public school student population contained therein. This, then, resulted in sample sizes of 20 questionnaires for Size A districts, 24 for Size B, 20 for Size C, 80 for Size D, 40 for Size E, 120 for Size F, and 96 for Size G.

There are only six Size G districts in Texas: Austin, Dallas, El Paso, Fort Worth, Houston, and San Antonio. Austin, with nine percent of the total number of students in this size district, thus received nine percent, or nine, of the 96 questionnaires allocated to this group. Dallas, with 24 percent, received 23 questionnaires; El Paso ten (ten percent); Fort Worth 12 (13 percent); Houston 31 (33 percent); and San Antonio 11 (11 percent).

Within each of the districts, the questionnaires were further divided among elementary education, secondary education, and special education personnel on the basis of the percentages previously indicated for these scholastic divisions (70, 28, and two percent, respectively).

In making up the samples for the districts of the other sizes, there were two factors to consider. One, as in the case of the Size G districts, was total percentage of student population as related to total number of districts; for example, on the basis of student population, a total of 120 questionnaires was allocated to the Size F districts, of which there happen to be 40. Then, using a standard sampling of every fourth district, it was determined that ten districts would receive the 120 questionnaires, and that 12 persons in each of the ten districts would each receive one. Again, these 12 persons were selected to provide proper distribution among the areas of elementary, secondary, and special education.

The second factor involved in selecting districts of Size F and smaller was a geographic one. The state was divided into five broad areas, as indicated in the table below and depicted in Figure IV-A.

Area	Geographic Scope	Regional Education Service Centers Covering the Area
East	Includes Beaumont, Houston, and Texarkana	IV, V, VI, VII, VIII; III, partially
North	Includes Dallas, Fort Worth, and the area from Wichita Falls to the Panhandle	IX, X, XI, XIV
Central	Includes the Austin and Waco areas; extends south to include San Antonio	XII, XIII; XV and XX, partially
West	Includes the Panhandle, the Trans-Pecos area, Midland, and Odessa; extends to El Paso	XVI, XVII, XVIII, XIX; XV, partially
South	South of San Antonio; includes Corpus Christi and the Rio Grande Valley	I, II; III and XX, partially

Table IV-b

CHARACTERISTICS OF RESPONDENTS

Respondents are described in terms of personal characteristics, attitudes toward change, geographic distribution and community characteristics, and availability of resources. The biographical data sheets on which teachers and administrators supplied information about themselves were identical; a copy is provided in Appendix Alfa.

Personal Characteristics

Age. Respondents ranged in age from under 25 years to over 50 years. Although the largest percentage of the teacher respondents were from 36 to 50, the remainder were evenly distributed between those under 35 and those over 50; administrators tended to cluster heavily in the 36 to over 50 age group. In the total sample, only 5.3 percent of the respondents were under 24, 11.9 percent were between 26 and 35, 50 percent were between 36 and 50, and 32.8 percent were over 50. Thus, considerable maturity in years is represented in the sample.

Sex. Among the total number of respondents 64.6 percent were men and 35.6 percent were women. However, as shown in Table IV-c, men tended to predominate among the administrators and women among the teachers.

PERCENTAGES OF RESPONDENTS BY SEX			
	Teachers	Administrators	Both
Men	29.3%	77.8%	64.4%
Women	70.7	22.2	35.6

Table IV-c

Highest degree earned. Among the respondents as a whole, 64 percent held master's degrees, either in education or in a subject discipline. Doctorates were held by 10.6 percent of the respondents and bachelor's degrees exclusively by 23.3 percent. Thus, respondents represent a relatively high educational level beyond minimum certification requirements.

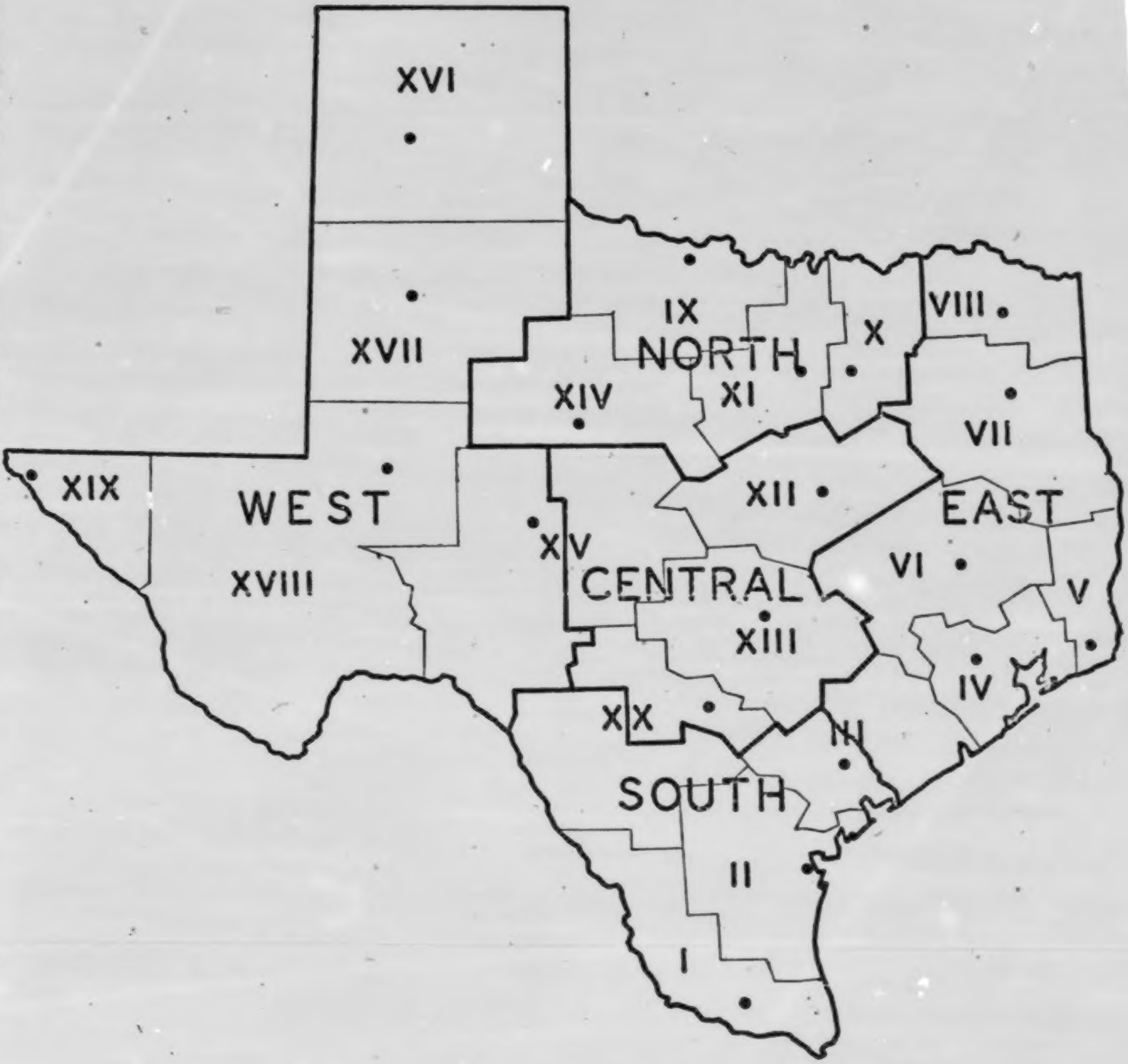
Years of experience. The years of work experience in education among respondents ranged from less than two years to over 25 years. The cluster range was from 15 to over 25 years of experience. Teachers tended to have fewer years of experience, with 23.1 percent of them having between 3 and 6 years and 20.5 percent of them having between 11 and 14 years. Over 85 percent of the administrators, on the other hand, indicated that they had 11 or more years of experience.

Titles or positions of respondents. School building level educators represented 53.3 percent of the respondents in the survey; teachers and administrators at the building level were evenly divided. District level administrative and curricular personnel represented 24.1 percent of the respondents; education service center personnel represented 15.3 percent; and college or university teacher educators represented 6.7 percent. Although the sample of respondents contained more administrators than teachers, this was thought to be, in part, defensible, since administrative personnel tend to be the decision makers in the implementation of new programs and the acquisition of new equipment and materials.

Respondents' grade levels and subjects. Among the respondents who indicated the grade levels of the pupils for whom they were responsible, 55.3 percent indicated elementary school level and 44.7 percent indicated secondary level.

Respondents represented a wide variety of subjects taught at either level. Many teachers indicated their subject simply as elementary education. Among the others, larger proportions of respondents taught mathematics, social studies, and language arts than any other subject areas. Librarians/learning resource specialists represented 9.8 percent of the respondents, special education personnel 4.2 percent, and bilingual teachers/administrators represented 1.7 percent. Other subject areas represented were fine arts and speech, business, science, foreign languages, vocational subjects, counseling, physical education, curriculum development, and in-service education.

SURVEY AREAS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I

Figure IV-A

Attitudes toward change. In the biographical data section of the questionnaire, respondents were asked about their perceptions of themselves in relation to change. Perhaps the very nature of the questions would tend to elicit responses in which respondents view themselves as responsive to change; however, 45 percent of the respondents indicated that they did not keep up sufficiently with information about instructional and educational technology, whereas 87.8 percent indicated that they did not mind change if they deemed the change for the better. Most respondents (93.2 percent) saw themselves as innovative, with no difference between the percentages of teachers and of administrators who viewed themselves as innovators. This statistic must be viewed with the understanding that those who responded to the questionnaire probably are innovative, ipso facto, whereas those who did not reply may not have wanted to contribute to uncertain technological changes and may not be innovative.

Geographic Distribution and Community Characteristics

Potential respondents were queried from all twenty regions served by Education Service Centers in Texas. Each region had one or more persons who responded to the survey; approximately 36 percent of the respondents represented four regions, namely those including the major metropolitan areas of Houston, Dallas, Fort Worth, and Austin, thus giving a somewhat smaller percentage of responses from the western and southern areas of the state.

District size. In developing the sample, careful attention was given to choosing stratified samples according to size of district by average daily attendance. The percentages of respondents from districts of varying sizes are displayed in Table IV-d.

PERCENTAGES OF TEACHER AND ADMINISTRATOR RESPONDENTS AND COMBINED RESPONDENTS ACCORDING TO SIZE OF DISTRICT IN AVERAGE DAILY ATTENDANCE

	Teachers	Administrators	Both
Under 1,500	15.0%	29.8%	25.5%
1,500-4,999	22.5	37.2	32.8
5,000-9,999	17.5	9.6	11.9
10,000-49,999	25.0	8.5	13.4
Over 50,000	20.0	14.9	16.4
TOTAL	100.0%	100.0%	100.0%

Table IV-d

Although the percentages of respondents do not match exactly the percentages of scholastics in districts of each size in Texas, the distribution of respondents throughout the range of district sizes indicates that responses are representative of the thinking of educators from districts of all sizes.

Ethnic, socio-economic, and cultural composition of respondents' districts. The number of ethnic groups represented by the districts in which respondents work ranged from one through six. Only 6.4 percent of the respondents indicated that their district was composed of solely one ethnic group. Fifteen percent indicated that two ethnic groups comprised the clientele of their district, and 59.3 percent indicated that their clientele was composed of at least three ethnic groups. Four groups were represented in 12.1 percent of the districts and five in 5.7 percent of the districts.

Additionally, respondents were asked to estimate the percentage of the classes of economic status of their districts in terms of rich, upper middle, middle, lower middle, and poor. In general, most respondents indicated that the rich and upper middle classes together comprised approximately one-sixth of their respective districts and that the remaining five-sixths was comprised of fairly even distributions of middle, lower middle, and poor classes. While there is some clustering, it appears that the districts of the respondents are still fairly diverse.

Respondents were further asked to describe their districts in terms of demographic characteristics and primary economic activity. The results are shown in Table IV-e.

NUMBER AND PERCENTAGES OF COMMUNITIES WITH GIVEN CHARACTERISTICS IN WHICH COMBINED RESPONDENTS WORK

Size	Number	Percentage	Character	Number	Percentage
Rural	12	9.0%	Industrial	13	14.0%
Small town	30	22.6	Agricultural	35	37.6
Small city	45	33.8	Commercial	18	19.4
Suburban	12	9.0	Inner city	12	12.9
Urban	34	25.6	College/university	15	16.1
TOTAL		100.0%	TOTAL		100.0%

Table IV-e

While 25.6 percent of the respondents characterized their district as urban, by far the largest percentage of respondents work in small towns or small cities. Agricultural communities predominate in terms of chief economic activity, with other economic characteristics being quite evenly distributed among districts.

Availability and Use of Resources

Respondents were queried concerning the presence in their district of a professionally staffed learning resource center (school library), the frequency and nature of their use of this facility, and the availability of telecommunications technologies.

Learning Resource Centers. Of the teachers and administrators who responded to the questionnaire, 75.5 percent indicated that they did have learning resource centers in their buildings and 24.5 percent indicated the absence of LRC's. Of the 75.5 percent with LRC's, 68.9 percent indicated that the center was staffed with a certified professional.

The frequency of teacher and administrator interaction with the LRC is shown in Table IV-f on the following page. The number of both administrators and teachers who indicated that they rarely or never used the LRC is rather distressing. Unfortunately, the biographical data sheet did not ask why an LRC may be so little used by educators, and one can only speculate that the resources, staffing, program, or combinations thereof are inadequate, or else that many teachers do not like using the "new-fangled" LRC's.

The questions which delved into the nature of interactions between respondents and the LRC may shed some light on the information above. Requests for materials were indicated by 29 percent of the teachers and 30 percent of the administrators, while only 8.1 percent of the teachers and 10 percent of the administrators indicated that information was volunteered by the LRC staff. The traditional checking in and out of materials accounted for a large part of usage, 28.3 percent overall. Teachers indicated rather frequent use of the LRC and its staff for instruction of students in using the resources and for informational discussions with staff members.

FREQUENCY OF USE OF LEARNING RESOURCE CENTERS	Teachers	Administrators	Both
Several times daily	2.8%	9.2%	7.3%
Daily	16.7	27.6	24.4
Weekly	36.1	26.4	29.3
Rarely	33.3	27.6	29.2
Never	11.1	9.2	9.8

Table IV-f

Educational television. Respondents were queried as to the availability of educational television channels and sets, as well as other telecommunications technologies. Of all the respondents, 34.4 percent indicated that they used educational television and 65.6 percent that they did not use it. The non-use may be in part due to the lack of channel availability, since 17 percent of the respondents indicated that they did not have an ETV channel available. Only one commercial channel was available to 67 percent of the respondents and two channels were available to 10.4 percent. Only 0.9% indicated four channels available, while 2.7 percent indicated five channels available.

The availability of TV receivers was also questioned. Black and white receivers were available to 51.5 percent of the respondents, and color receivers were available to only 30 percent. The location of sets may also account for some of the use or non-use of educational television broadcasts; locations of sets are shown in Table IV-g.

LOCATION OF TV RECEIVERS AVAILABLE TO RESPONDENTS FOR EDUCATIONAL TV	Teachers	Administrators	Both
Classroom	32.0%	42.7%	40.0%
Library/media room	40.0	22.6	27.0
Both library/media room and classroom	-0-	10.7	8.0
Other	28.0	24.0	25.0

Table IV-g

Respondents were also asked about the availability of cable television, closed circuit systems, and other electronic technologies. Cable television was indicated as being available to only 22.3 percent of the respondents, and 7.2 percent did not know whether it was available or not. Closed circuit TV systems within buildings or school systems were indicated as being available to 22.6 percent of the respondents, raising some suspicions on the part of the investigators that the terminology of "cable television" and "closed circuit television" may have been confused. Other electronic communications channels were indicated as being available to 19.6 percent of the respondents, with a high proportion, 23.2 percent, not knowing whether they were available or not. These other systems indicated as being available included intercom (public address system), microwave capability, CAI, wireless loops, telelecture, ERIC terminals, teletype, two-way video, data processing and computer terminals, and language laboratories.

FINDINGS FROM THE QUESTIONNAIRE

Separate questionnaires were sent to teachers and administrators, although 111 of the questions were identical for both groups of respondents. The remaining questions differed for teachers and administrators.

A large portion of the questionnaires consisted of queries asked of both teachers and administrators; the questions related to instructional problems, instructional needs, attitudes toward technology, and the opinions and assumptions which both groups held about educational technology in the schools.

Additional Instruction Needed

Overview. In the first set of questions, both groups were asked for opinions about needs for information for teachers to improve instruction. The actual question was:

> To what extent is additional instruction (or lesser amounts of information) needed on the following topics so that teachers may improve instruction in the schools?

There were 15 topics, including such items as structure of knowledge, team teaching, and computers in school; respondents were given five choices of reply to each, ranging from urgently needed through needed, unknown, and not needed to definitely not needed. The results are summarized in Table IV-h, with almost all respondents showing a need, and administrators indicating a somewhat stronger need. Less than 10 percent of the respondents saw no need or felt that the additional instruction would be undesirable.

SUMMARY OF RESPONSES BY TEACHERS AND ADMINISTRATORS CONCERNING THE NEED OF TEACHERS FOR MORE INFORMATION, AS DESCRIBED IN TERMS OF FIFTEEN DIFFERENT TOPICS

	Urgent Need	Moderate Need	Adequate As Is	Not Needed/Highly Undesirable
Teachers	21.5%	40.4%	28.6%	9.5%
Administrators	30.1	45.0	19.5	5.4
Both	27.7	43.8	22.0	6.5

Table IV-h

Detail. The following is a discussion of the detailed information to be found in Appendix Bravo-1. It can be seen there that on only two items did at least 10 percent of the teachers and administrators combined feel that additional information was unnecessary: open schools and use of computers in schools. Ten percent of the teachers felt that additional information was not needed on information retrieval and 17 percent felt that it was not needed on team teaching, although administrators saw more need for data on these two topics.

Both teachers and administrators considered information on sources of content knowledge, information retrieval, and structure of knowledge to be most adequate. Again, a larger percentage of teachers than of administrators perceived this information as presently adequate. The greatest discrepancies between teacher and administrator perceptions of information as adequate were in the areas of cognitive development, affective teaching, and self-instructional methods. On each topic, teachers viewed their knowledge as more adequate than administrators viewed it. On only one topic, the changing role of the school, did administrators feel that teachers had more adequate knowledge than the teachers themselves indicated.

The combined responses of teachers and administrators indicated that the areas of most urgent need were learning styles, planning and organizing for instruction, affective teaching, and applied behavior modification. Administrators felt that teachers had the greatest needs for more information about learning styles, developing learning modules, planning and organizing instruction, and affective teaching. Teachers felt that their greatest needs were for information about learning styles, planning instruction, affective teaching, and applied behavior modification.

All items in Appendix Bravo-1 indicate that more than two-thirds of the combined groups perceived a need for additional information on the topics listed. Items on which teachers expressed a particular need for information were the changing role of the school and educational applications of recorded media. Administrators perceived teachers' greatest information needs to be on the same two topics, as well as on structure of knowledge, team teaching, and self-instructional systems. Differences between teachers' and administrators' perceptions were fewest in the indication of information that they saw as moderately needed; urgent needs saw a ten percent separation.

Performance of Teaching Tasks

Overview. In the next question, teachers and administrators were asked their opinions on teachers' need for assistance in performing certain tasks better. The question was as follows:

> To what extent do you feel that teachers desire assistance in improving the overall performance of the following tasks?

The tasks specified included diagnosing individual pupil learning difficulties; defining educational objectives; devising testing/measuring instruments; directing student investigations; communicating with pupils in nonstructured situations; and selecting/developing materials.

Respondents were asked to reply in terms of the same five categories indicated above; the results are given in Table IV-i. Again, both teachers and administrators perceived considerable need for additional assistance to teachers in helping them improve their overall teaching performance. While these tasks are not all formal classroom activities, they appeared to be related to the possible use of technology in instruction, and therefore were included in the survey instrument.

SUMMARY OF RESPONSES OF TEACHERS AND ADMINISTRATORS ABOUT THE NEED OF TEACHERS FOR MORE ASSISTANCE WITH CERTAIN TEACHING SKILLS, AS DESCRIBED IN TERMS OF SIXTEEN DIFFERENT TASKS

	Urgent Need	Moderate Need	Adequate As Is	Not Needed/Highly Undesirable
Teachers	27.7%	38.9%	29.6%	3.8%
Administrators	32.0	41.2	22.1	4.7
Both	30.9	40.7	24.2	4.2

Table IV-i

Detail. It can be seen that close to three-fourths of the respondents saw an urgent or moderate need for more assistance to teachers. Administrators appeared to be more cognizant of the need than were the teachers themselves, who seemed more satisfied with present performance. About one-fourth of both groups saw no need for further assistance. Appendix Bravo-2 shows the full spread of questions and responses.

At least 40 percent of the combined group saw a need for assisting teachers in diagnosing individual learning difficulties, prescribing individualized instruction, presenting information interestingly, motivating pupils to think for themselves, and relating instruction to everyday life. This list includes four tasks that are essentially learner-centered and one that is teacher-centered. Teacher responses, as compared with those of administrators, indicate that the teachers who responded felt more need for help in presenting information interestingly, in motivating pupils to think for themselves, and in relating instruction to everyday life than did administrators. On the other hand, administrators judged teachers as needing more help with diagnosing individual learning difficulties, defining objectives, stating objectives in measurable terms, directing student evaluation, communicating with pupils in nonstructured situations, and selecting and developing materials.

Tasks that teachers felt they performed most adequately were defining objectives, devising tests, assigning grades, and directing student evaluations. In none of the responses in these areas did administrators think that teachers' skills were as adequate as the teachers thought they were. Only a very small percentage of teachers or administrators thought that teachers did not need assistance in improving their performance of the tasks listed in Appendix Bravo-2.

Needs for Assistance in Instruction

Overview. In this question, respondents were asked the extent to which they felt that teachers needed assistance with teaching certain skills or processes. The question was:

> To what extent do teachers need assistance in teaching the following skills/processes more effectively?

The various skills and processes included spoken and written English, speaking and writing a foreign language, reading for meaning, arithmetic concepts, finding sources of information, synthesizing information, and enhancing creative approaches. The question implied that direct instruction could be given to pupils or that assistance could be provided to teachers to enable them to instruct more effectively in these processes and skills. The same five categories of response were provided; a summary of the responses is given in Table IV-j. Again, teachers and administrators saw a strong need for assistance to teachers in all these areas.

SUMMARY OF RESPONSES OF TEACHERS AND ADMINISTRATORS ON THE NEED FOR ASSISTING TEACHERS IN THE DEVELOPMENT OF TWENTY-THREE DIFFERENT SKILLS/PROCESSES IN STUDENTS

	Urgent Need	Moderate Need	Adequate As Is	Not Needed/Highly Undesirable
Teachers	27.0%	44.7%	26.7%	1.6%
Administrators	31.9	45.2	20.0	2.9
Both	30.6	45.1	21.9	2.4

Table IV-j

Detail. Again, administrators saw a more pressing need than did teachers, and three-fourths of both saw an urgent to moderate need for assisting teachers in developing such skills in their pupils. Appendix Bravo-3 contains the full set of questions and responses.

A combination of teachers and administrators indicated that the most urgent need for assistance was in helping pupils learn to read for meaning; 58 percent of the total number of respondents saw an urgent need for improving this process, with 63.4 percent of the teachers indicating this and 56 percent of the administrators. On a related process, reading in content subjects, 42.7 percent of all respondents, 45.9 percent of the administrators, and 34.1 percent of the teachers saw the need for assistance as urgent. Other items on which at least one-third of the combined teacher-administrator respondents felt a need for assistance were vocabulary development, creative writing (but not expository or persuasive writing), abstract reasoning, analysis of a problem, organizing information, synthesizing information, enhancing creativity, and building performance skills.

The largest percentages of combined respondents indicated a moderate need for assistance on items dealing with finding relevant information, note taking, and information recording skills. Approximately equal percentages of respondents found these skills either to be adequate or to be urgently needed.

In general, 15 to 30 percent of the respondents judged the skills and processes listed in Appendix Bravo-3 to be adequately mastered. Strangely, those at which they deemed themselves and pupils most adequate were writing and speaking a foreign language. Although almost all items had a scattering of responses indicating that given respondents felt assistance was not needed or definitely not needed, by far the preponderance of respondents felt the need for help in teaching the skills and processes listed.

Areas Where Technology Might Aid Learning

Overview. In this question, respondents were queried concerning their opinions about the disciplines or subjects usually taught in schools which might be amenable to the use of media and technology in order to improve the quality of pupil learning. The question was:

> In which of the following content areas of instruction do you feel that the use of media and technology would be most useful in helping to improve the quality of pupil learning?

Content areas listed were language arts, mathematics, science, social studies, foreign language, fine arts, vocational education, career education, physical education, special education, and "other." Respondents tended to view instruction as most adequate and least in need of educational technology in the areas of physical education, foreign language, fine arts, and mathematics. They saw the least need for educational technology in physical education. A summary of responses to the question, in the same five categories, is provided in Table IV-k.

SUMMARY OF TEACHERS' AND ADMINISTRATORS' OPINIONS ON WHETHER MEDIA OR TECHNOLOGY COULD BENEFIT TEACHING, AS DESCRIBED IN TERMS OF TEN DIFFERENT SUBJECTS TAUGHT

	Urgent Need	Moderate Need	Adequate As Is	Not Needed/Highly Undesirable
Teachers	36.4%	41.1%	19.7%	2.8%
Administrators	36.7	45.4	16.7	1.2
Both	36.4	44.2	17.5	1.9

Table IV-k

Detail. Some care must be exercised in using this summary, because the really important elements are associated with each line item, rather than with the total, as seen in Appendix Bravo-4. Although physical education was given the least support among the ten subjects or disciplines, even that showed more than 60 percent of the respondents indicating an urgent or moderate need for technology to improve learning. In all subjects taken together, more than 80 percent of the respondents recommended the use of media or technology.

Areas in which they saw the greatest potential for educational technology were science, career education, special education, social studies, and vocational education. Teacher and administrator responses tended to be quite similar, with the greatest discrepancy being that 50 percent of the teachers and 42.2 percent of the administrators felt that there was an urgent need for more use of technology in special education. Teachers and administrators also tended to agree on areas of moderate need for the use of technology, except that in fine arts administrators saw much more potential.

A cross-tabulation of teachers' specialties or the subjects they taught with the items in this section produced no marked differences between the perceptions of all teacher respondents. The only generalizable information secured from the cross-tabulations was that elementary level teachers tended to see an urgent need for technology more readily than those in other subject areas.

Attitudes Toward Given Technologies

Overview. In this question, teachers and administrators were asked how necessary and desirable they thought nine different technologies were (provided the appropriate equipment and software were available). Technologies listed included audio cassettes or tapes, television, video tape or recordings, motion picture films, long distance transmission of printed and pictorial information, and more elaborate dial access, TV, computer, and audio systems. As a whole, both groups of respondents tended to view the technologies as both necessary and desirable, in terms of the same five categories. Responses are summarized in Table IV-1.

TEACHERS' AND ADMINISTRATORS' OPINIONS ABOUT THE DESIRABILITY OF AND NECESSITY FOR EDUCATIONAL TECHNOLOGY, AS DESCRIBED IN TERMS OF NINE DIFFERENT TECHNOLOGIES

	Urgent Need	Moderate Need	Adequate As Is	Not Needed/Highly Undesirable
Teachers	30.1%	39.6%	15.6%	14.7%
Administrators	35.6	43.1	13.8	7.5
Both	34.2	42.1	14.3	9.4

Table IV-1

Detail. Again, more than three-fourths of the respondents saw a need, varying from modest to urgent, for media and technology. Administrators were somewhat more supportive of the needs than teachers. The entire range of questions and responses is shown in Appendix Bravo-5.

Predictably, the largest number of negative responses involved those technologies which are less well-known and which provide for two-way communications capabilities, such as television response systems, computer systems for individual instruction and testing of pupils, and audio active systems.

Since audio cassettes and tapes are so common, it was somewhat surprising to find that only 10.7 percent of the respondents thought these technologies were adequate at present. Television, another technology that has been available for some time, was judged as adequate by only 13.9 percent of the respondents and as not needed by 7.3 percent, and motion pictures were judged adequate by only 14.6 percent.

When examining the column in Appendix Bravo-5 that indicates percentages of respondents who see an urgent need for given technologies, one finds that audio cassettes and tapes rank as the most urgent need, followed by audio active systems and motion pictures, and then by television and computer-aided systems. In general, administrators seemed to sense a greater need for most of the technologies than did teachers.

One item in Appendix Bravo-5 which may have been misunderstood was the one concerned with long distance sending and receiving of printed and pictorial information, whether by teletype, video signals, slow scan television, long distance xerography, or some other system. Twenty-nine percent of the respondents judged this technology as adequate, raising the suspicion that they may not have been thinking of specifically electronic transmissions but rather of mail, delivery by truck, or other means.

Cross-tabulations were run on the items in Appendix Bravo-5 with a number of respondents' characteristics in an attempt to discover whether respondents answered differently if they were from schools of any particular size, from schools with or without learning resource centers, or from schools with or without educational television available; or if they worked in different positions, or had varying totals of years of experience in education.

There appeared to be no relationship between the number of years that respondents had spent in education and their responses to the need for and desirability of various technologies; nor did there seem to be any relationship between responses and whether respondents used educational television; nor between responses and the frequency with which educational television was used. The number of educational channels available did seem to bear some small relationship to an expressed need for other technologies: respondents with two or more channels available were more receptive to other technologies.

The presence or absence of learning resource centers affected few answers except that respondents with LRC's saw more need for audio cassettes and tapes and for computer-aided instruction. Those without LRC's saw more need for long distance transmission of pictorial and verbal information. The items in Appendix Bravo-5 were also cross-tabulated with the presence or absence of a professional, certified staff member in the LRC. Respondents without the aid of professionals expressed a greater need for video recording and long distance transmission of pictorial and verbal information. There was no difference between the expressed needs for other technologies except audio, where respondents who had the services of a learning resource specialist available again indicated a greater need for audio cassettes and tapes.

The expressed needs for various technologies were further cross-tabulated with the size of school districts in which respondents worked. An interesting pattern was evident in this cross-tabulation: respondents from the largest districts (50,000 ADA and over) tended to feel the most urgent need for the technologies listed and those from the smaller districts (under 5,000 ADA) tended to express the lowest level of need. In many cases, respondents from districts with ADA's of between 1,500 and 5,000 indicated that they found the availability of the technologies to be more adequate than did respondents from any other districts. For this sample, at least, it appears that the smaller districts do not see the need for expanded technology, either because it is already available, because they are not acquainted with what it can do for the students in their schools, or because they find it philosophically incompatible with their programs. Additional detailed supporting data are available in the form of computer printouts.

A final cross-tabulation was run between the positions which respondents held and the degree of need which they expressed for the technologies listed in Appendix Bravo-5.

In general, responses concerning any given technology were similar for teachers, administrators, and teachers/administrators combined. A few discrepancies were evident, however. In the use of video recordings, education service center personnel tended to see a higher level of need, 64.7 percent as compared with an overall mean of 36.7 percent. In the use of audio cassettes and tapes, ISD level curriculum and supervisory personnel indicated a much higher need, 81.8 percent, as compared with a mean of 53.7 percent for all respondents. In the use of dial access systems, ISD administrative personnel indicated a much higher moderate need (57.1 percent) and consequently a higher total need (78.5 percent) than did all other respondents (44.0 percent).

Perceptions of Support for Technologies

Overview. In this question, respondents were asked to indicate their perceptions of the support which the same technologies discussed in Appendix Bravo-5 would receive from school board members and from parents if the supporting funds had to come entirely from local sources.

The two questions (combined) were:

> Given a situation in which adequate tapes, films, programs, and accompanying equipment are available, what is the attitude that you think your school board/most parents in your district would have toward using the technologies below in your school system if they were not provided through state funding and had to be paid for by local taxes and funding?

The five categories of response provided were strongly support, probably support, unknown, probably do not support, and vigorously oppose. Throughout their responses, teachers and administrators were quite consistent in their judgments of support. On many items, they felt that parents would be less supportive of funding the technologies used in schools than would school board members. The summaries of the responses are shown in Tables IV-m and IV-n. While the high percentage of "unknown" responses makes the usefulness of the data somewhat questionable, this response is probably a very honest one on the part of the respondents.

TEACHERS' AND ADMINISTRATORS' OPINIONS ABOUT THE ATTITUDE OF LOCAL SCHOOL BOARDS REGARDING LOCAL FUNDING OF EDUCATIONAL TECHNOLOGY, AS DESCRIBED IN TERMS OF NINE DIFFERENT TECHNOLOGIES

	Strongly Support	Probably Support	Unknown	Probably Not	Vigorously Oppose
Teachers	13.9%	33.2%	26.9%	21.5%	4.5%
Administrators	13.7	30.6	28.6	22.8	4.3
Both	13.9	31.2	28.1	22.4	4.4

Table IV-m

Detail. As Appendix Bravo-6 indicates, most opposition by parents would seem to be to television response systems, and most opposition by board members to computer-aided instruction, dial access systems, and long distance transmission of pictorial and verbal information. It is reiterated that the questions were phrased entirely on the basis of 100 percent local funding.

Respondents were also asked to indicate that degree of support that they thought parents would lend to the use of the same technologies in the schools if the technologies were supported by state rather than local funding. Taking the technologies as a group, 35.1 percent of the respondents indicated strong support, 55.7 percent indicated support, 8.4 percent were uncertain, and only 0.8% indicated no support. Thus, it is clear that the issue of local funding was a critical one in the responses to the previous group of questions.

TEACHERS' AND ADMINISTRATORS' OPINIONS ABOUT THE ATTITUDE OF PARENTS REGARDING LOCAL FUNDING OF EDUCATIONAL TECHNOLOGY, AS DESCRIBED IN TERMS OF NINE DIFFERENT TECHNOLOGIES

	Strongly Support	Probably Support	Unknown	Probably Not	Vigorously Oppose
Teachers	10.8%	36.8%	28.7%	17.6%	6.1%
Administrators	13.8	33.3	31.7	20.1	1.1
Both	13.0	34.3	30.8	19.4	2.5

Table IV-n

Cross-tabulations were made between responses about parental and board member support and size of district, existence of a learning resource center in the school, and availability of educational television in the school to determine whether any of these factors might have served as a catalyst in formation of the attitudes expressed.

Comparison of the answers of respondents concerning school board support of technology as related to size of school district produced few differences of any magnitude. For four of the technologies suggested (audio cassettes and tapes, video recording, long distance electronic transmission, and response television systems) respondents from school districts with an ADA of under 1,500 indicated the least support. The same was true of parental support if funding had to come from local sources. Respondents from districts with an ADA between 5,000 and 50,000 gave the most answers of "unknown" or "uncertain."

Responses concerning support of board members and parents for the same technologies were related to the presence of centralized learning resource centers in the schools. Answers concerning potential support of board members varied, but indicated that schools that had centralized LRC's might obtain more support from their boards for television, video recording, and computer-based systems. Respondents from schools without learning resource centers felt a great deal more negative about support for computer-based learning systems, 52.9 percent as compared with 32.7 percent from schools with LRC's.

Respondents from schools which used educational TV broadcasts indicated higher levels of support from both parents and board members for audio cassettes/tapes than for any other of the technologies, but, in general, use of educational TV tended to correlate positively with a favorable attitude toward support of other technologies.

Thus, in considering the various breakdowns of responses from schools of different sizes and with different resources, there is no pronounced difference in their attitudes toward support of educational technology except that small districts are very cautious about local financial support.

Effects of Technology on Various Subsystems: Need for Specialized Personnel

Overview. Respondents were asked in this question to indicate their degree of agreement or disagreement with a number of statements that assessed their perceptions about the effects of educational technology on the various subsystems of a school system, such as personnel deployment, utilization of teacher time, and teacher control of instruction. In the area of need for specialized personnel, statements (combined) were as follows:

> In order to select appropriate methods to help individual pupils learn best from the varieties of educational technology available, teachers need the help of a learning resources selection and utilization specialist.
>
> The introduction of educational technology into a school also requires the addition of an equipment maintenance specialist to the school staff/the assistance of a testing and measurement specialist/the availability of design and production staff to help teachers prepare materials.

Categories of responses were strongly agree, agree, have no opinion, disagree, and strongly disagree. The results of teacher and administrator responses to the statements concerning the need for specialized personnel and deployment of personnel are shown in Table IV-o. Full tables are presented in Appendix Bravo-7 and include combined data not shown below.

PERCEPTION OF NEED FOR SPECIALIZED PERSONNEL AND POSITIONS*										
Teachers' and Administrators' Views of the Need for:	Strongly Agree		Agree		No Opinion		Disagree		Strongly Disagree	
	T	A	T	A	T	A	T	A	T	A
Resource Specialists	36.6%	34.5%	39.0%	54.5%	9.8%	7.3%	14.6%	2.7%	-0-%	0.9%
Maintenance Specialists	29.3	26.4	36.6	45.5	22.0	14.5	9.8	12.7	2.4	0.9
Testing and Measurement Specialists	17.1	10.1	24.4	28.4	36.5	25.7	22.0	31.2	-0-	4.6
Production Specialists	29.3	19.1	48.8	51.8	9.8	16.4	12.2	12.7	-0-	-0-

Table IV-o

Detail. The need for specialized personnel in selection and utilization of learning resources appears particularly strong; administrators expressed a higher degree of agreement that such personnel are needed than did teachers. Since 14.6 percent of the teachers disagreed that such personnel were required in a school using educational technology, one must assume either that teachers feel competent to perform such tasks themselves or that their experience with such personnel in the past has not been positive.

Since maintenance often becomes a critical problem with highly sophisticated technologies, respondents were queried about whether they agreed or disagreed that specialized maintenance personnel were required. Again, a preponderance of both teacher and administrator respondents indicated a need for such personnel, with 16.6 percent having no opinion and 13.3 percent indicating that they did not think such personnel were required. There was no clear-cut pattern of differences in the responses of teachers and administrators.

Respondents indicated less need for testing and measurement specialists than for any other special personnel. Only 12 percent saw them as urgently needed and 27.3 percent as moderately needed, whereas 28.7 percent thought they were not needed.

Respondents were also asked whether the extensive use of educational technology required the availability of design and production staff to help teachers prepare materials. A total of 72.9 percent of the respondents indicated either an urgent or a moderate need for such personnel, while only 12.6 percent thought they were not needed. Teachers tended to express a slightly more urgent need, but more administrators expressed a moderate need for design and production personnel.

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*Because of rounding of figures, the percentage totals in this table and those to follow may not always add up to 100.0%; however, the sums are never off by more than 0.1%.

Administrators' responses were cross-tabulated with the positions which they held. District level administrators saw less need for learning resource specialists than did building level administrators, district level supervisors, service center personnel, or college/university faculty members. Building level administrators saw more need for special testing and measurement assistance than did other administrators.

Effects of Technology on Various Subsystems: Effect on Teaching Tasks

Overview. Respondents were also queried concerning their perceptions of the effect that technology has on teaching tasks. Statements (combined) in this area were as follows:

> The use of educational technology in schools frees the teacher from lecturing and consequently allows more time to be spent with individual pupils.
>
> Using educational technology takes more teacher time than traditional teaching methods/improves teaching effectiveness for the time invested/requires that teachers invest more time in scheduling and preparation/requires that teachers spend more time following up on what pupils have learned/requires more teaching skills than other approaches.

The five categories of response were the same as for the previous group of statements; responses are displayed in Table IV-p, with full tables and data for the combined (teacher/administrator) group in Appendix Bravo-7.

EFFECT TECHNOLOGY HAS ON TEACHING TASKS

Teachers and Administrators Feel Educational Technology:	Strongly Agree		Agree		No Opinion		Disagree		Strongly Disagree	
	T	A	T	A	T	A	T	A	T	A
Frees the teacher	22.0%	43.1%	46.3%	42.2%	2.4%	2.8%	22.0%	11.0%	7.3%	0.9%
Takes more time	9.8	11.9	36.6	38.5	14.6	11.0	36.6	33.0	2.4	5.5
Provides better effectiveness	19.5	34.9	53.7	53.2	12.2	5.5	12.2	5.5	2.4	0.9
Requires more preparation	22.0	33.6	61.0	49.1	2.4	10.0	14.6	7.3	-0-	-0-
Requires more follow-up	14.6	20.9	51.2	52.7	14.6	10.0	19.5	16.4	-0-	-0-
Needs more skills	17.1	13.6	24.4	47.3	31.7	12.7	26.8	24.5	-0-	1.8

Table IV-p

Detail. Most respondents indicated that they thought that the use of technology freed the teacher from lecturing and consequently allowed more time to be spent with individual pupils. A higher percentage of administrators (85.3 percent) than of teachers (68.3 percent) indicated agreement, whereas 22 percent of the teachers indicated disagreement and 7.3 percent strong disagreement.

Respondents were asked whether they agreed or disagreed that the use of educational technology took more teacher time than traditional teaching methods. Teacher time was not defined for the respondents. Only 49.3 percent of the combined respondents indicated that they thought it took more time, whereas 39 percent of the teachers disagreed. Among administrators, 38.7 percent thought that it took more time, with cross-tabulations indicating that 64 percent of district level administrators felt that it took more time.

Respondents agreed rather strongly that using educational technology improved teaching effectiveness for the time invested; a total of 84 percent agreed with this statement. Disagreement was expressed by 12.2 percent of the teacher respondents. The lowest level of agreement among administrators, as determined by cross-tabulation, was for building level administrative personnel.

Both teachers and administrators agreed strongly with the statement that using educational technology took more time in scheduling and preparation. Respondents also agreed quite strongly that using educational technology required teachers to spend more time in following up on what pupils had learned, although a higher percentage of them disagreed that more time was needed for follow-up than that which was needed for scheduling and preparation.

Respondents were more divided on the question of whether using educational technology required more teaching skill than other approaches. Strong agreement was expressed by 14.6 percent and agreement by 41.1 percent, but disagreement was expressed by 25.2 percent and strong disagreement by 1.3 percent. A rather high percentage of teachers (31.7 percent) had no opinion as to whether more skill was required, perhaps indicating that they had limited training and/or experience in the area.

Effects of Technology on Various Subsystems: Teacher Control of the Instructional Situation

Overview. Respondents were also asked to express their agreement or disagreement with several statements concerning teacher control when using educational technology. In this area, the statements (combined) were as follows:

> Using educational technology creates disciplinary problems in a class/causes the teacher to lose control of scheduling of pupil activities/causes the teacher to lose control of what is taught/necessitates too much coordination on the part of the teacher to be worth the effort.
>
> Teachers cannot be expected to write, develop, and produce programs and content to be used in systems employing educational technology.

The five categories of responses remained the same. Responses are shown in Table IV-q; full tables and data for the combined group are given in Appendix Bravo-7.

Detail. Teachers and administrators disagreed rather strongly that using educational technology created disciplinary problems, with 77.5 percent of the total number of respondents indicating that it did not.

A somewhat surprising response was given to the statement that when using educational technology the teacher lost control of scheduling of pupil activities. Only 5.4 percent of the respondents thought that the teacher lost control of scheduling; 80.6 percent thought there was no loss. Administrators tended to disagree with the statement more strongly than did teachers; 14 percent of district level administrators, according to the cross-tabulations, felt that teachers lost control of timing.

The degree to which teachers may lose control of the content that is taught when using educational technology was also queried. Again, respondents disagreed resoundingly with the idea that educational technology causes the teacher to lose control of content.

TEACHER CONTROL OF THE INSTRUCTIONAL SITUATION

Teachers and Administrators Feel Educational Technology Causes:	Strongly Agree		Agree		No Opinion		Disagree		Strongly Disagree	
	T	A	T	A	T	A	T	A	T	A
Disciplinary problems	2.4%	2.7%	7.3%	3.6%	31.7%	9.1%	51.2%	56.4%	7.3%	28.2%
Loss of scheduling control	2.4	3.7	2.4	1.9	24.4	10.2	63.4	60.2	7.3	24.1
Loss of subject control	2.4	4.5	4.9	2.7	14.6	4.5	70.7	59.1	7.3	29.1
Need for too much coordination	2.4	-0-	17.1	4.5	19.5	4.5	48.8	63.6	12.2	27.3
Lack of teacher-developed programs	14.6	9.1	24.4	23.6	26.8	14.5	24.4	47.3	9.8	5.5

Table IV-q

As to whether teachers should be expected to write, develop, and produce programs and content to be used in systems employing educational technology, respondents were somewhat divided, with more of them disagreeing that teachers should be expected to perform this task than feeling that teachers should write, develop, and produce programs. Such responses would corroborate the statement made earlier that teachers perceived a need for specialized personnel to help with design and production of materials.

Respondents were also asked whether using educational technology required too much coordination on the part of the teacher to be worth the effort. Only 15.6 percent indicated that it did, and 8.6 percent had no opinion. Thus, by far the largest percentage of the respondents felt that the coordination required was worth the effort invested by teachers.

Other Questions (See Appendix Bravo-8 for tables.)

In order to ascertain the feelings of teachers about educational technology which students might use on an individual basis without teacher supervision, and very likely away from the school building, respondents were asked whether they would find desirable or undesirable a development in which pupils obtained learning programs two days per week for independent study at home through their TV sets or other equally simple and available technologies. A total of 16.6 percent judged such a development highly desirable, 32.5 percent thought it desirable, 31.1 percent were undecided, 17.2 percent thought it undesirable, and 2.6 percent thought it highly undesirable. Teacher and administrator responses were similar, with administrators finding the potential development a few percentage points more desirable than did teachers. Cross tabulation indicated that 80 percent of education service center personnel judged such a development desirable or highly desirable.

Respondents were also asked their preferences for modes of in-service programs in which they might participate. Possible responses ranged from a strong preference for individualization to a strong preference for group sessions. By far the largest percentage of respondents (51.2 percent of the teachers and 40.7 percent of the administrators) indicated that they would prefer in-service programs with equal amounts of group and individual activity. Only 8.1 percent of all respondents expressed a strong preference for totally individualized programs and 12.1 percent for totally group-oriented programs.

In a rather complex question, respondents were asked their opinions about the relationship between accountability and technology. An overwhelming 88.2 percent indicated that they felt that technology could improve teaching, 10.7 percent were undecided, and 2.0 percent felt that technology might cause loss of classroom control. Only a very few felt that the use of technology caused educators to become more vulnerable.

Respondents were also asked to assess the skills related to the use of educational technology that most beginning teachers possessed upon completion of their pre-service programs. Beginning teachers were judged as slightly skilled by 55.4 percent of respondents, as skilled by only 13.5 percent, and as very unskilled by 13.5 percent, a clear indication of changes needed in teacher education programs.

INFORMATION SUPPLIED BY TEACHERS ONLY

Willingness to Use Technology in In-Service

Overview. Teachers who responded to the questionnaire were asked about their willingness to use given technologies to improve their skills through in-service activities. The same questions were asked of situations in which teachers had released time from classes for such activities and of situations in which they were participating in the activities after school on their own time; specific questions (combined) were as follows:

> Indicate on your answer sheet your willingness to use the technologies listed below to improve your skills through in-service activities during released time from instruction during the school day/held after school or accomplished on your own time outside the school day.

Categories of response were very willing, willing, undecided, unwilling, and very unwilling. As might be expected, teachers preferred released time for such activities, but not as overwhelmingly as might have been anticipated. Responses are displayed in Table IV-r.

EXPRESSED WILLINGNESS OF TEACHERS TO USE EDUCATIONAL TECHNOLOGY FOR IN-SERVICE LEARNING ON RELEASED TIME AND ON THEIR OWN TIME

	Very Willing		Willing		Undecided		Unwilling		Very Unwilling	
	Rel.	Own	Rel.	Own	Rel.	Own	Rel.	Own	Rel.	Own
Television	24.4%	-0-%	46.3%	37.5%	22.0%	32.5%	7.3%	20.0%	-0-%	10.0%
Computer-assisted instruction	17.1	4.9	39.0	31.7	29.3	31.7	14.6	24.4	-0-	7.3
Motion picture	29.3	2.4	56.1	51.2	9.8	14.6	4.9	24.4	-0-	7.3
VTR	22.0	4.9	56.1	46.3	22.0	26.8	-0-	14.6	-0-	7.3
Audio	39.0	14.6	51.2	51.2	7.3	14.6	-0-	9.8	2.4	9.8
Automated search citations	4.9	4.9	31.7	17.1	56.1	48.8	7.3	19.5	-0-	9.8
Automated search facsimiles	2.4	2.4	31.7	22.0	56.1	43.9	7.3	22.0	2.4	9.8
Dial access	2.4	4.9	43.9	31.7	46.3	36.6	4.9	17.1	2.4	9.8

Table IV-r

Detail. The large number of responses in the undecided column indicate that the nature of the technologies suggested for use in in-service programs may be a more critical factor than the fact that an activity is engaged in by teachers on released time or on their own time. Those technologies which teachers indicated the greatest willingness to use, either on their own or on released time, were the more familiar and commonly used technologies: motion pictures, video recording, and audio tapes and cassettes. The technology which teachers indicated the least willingness to use was the computer, especially on their own time. On their own time they also expressed reservations about using automatic search and facsimile transmission, dial access, automated search providing citations to articles, and some computer-aided activity. These responses would seem to indicate that unfamiliarity with the technology and the possible need to use it without assistance influenced the responses regarding willingness to use it.

INFORMATION SUPPLIED BY ADMINISTRATORS ONLY

Local Support for Technology

Overview. In addition to the questions discussed previously in which respondents indicated their perceptions of board members' and parents' support of educational technology from local funds, administrators were also asked about the percentage of local financial support they would be willing to recommend for certain cost items inherent in implementing a telecommunications system in a school. The question was as follows:

> If the programming and software for telecommunications were provided for all schools in Texas by the state, indicate the portion of the cost of each item that you would be willing to bear from local funds in order to have the programming available to pupils in your school. (Mark one response for each question.)

Categories of response were none, 0-25%, 26-50%, 51-75%, and 76-100%. Responses of the administrators are shown in Table IV-s.

ESTIMATES OF LOCAL FINANCIAL SUPPORT FOR EDUCATIONAL TECHNOLOGY					
	None	0-25%	26-50%	51-75%	76-100%
Long distance costs	37.1%	48.5%	9.3%	5.2%	-0-
Antenna systems	20.8	46.9	17.7	10.4	4.2
Campus distribution	13.7	47.4	26.3	10.5	2.1
TV receivers	9.4	36.5	27.1	13.5	13.5
Computer terminal rental	25.0	45.8	18.7	6.3	4.2
Recording equipment	11.6	38.9	30.5	14.7	4.2
Printed instructions	10.5	46.3	22.1	15.8	5.3
Staff salary	14.7	42.1	26.3	8.4	8.4
Maintenance personnel	18.7	39.6	22.9	9.4	9.4
Software costs	27.2	48.9	15.2	6.5	2.2

Table IV-s

Detail. As the table indicates, relatively small percentages of administrators would be willing to expend more than 50 percent of the cost of any given item from local funds. Items for which they were most willing to expend 50 percent or more of local funds were printed programmed instruction, maintenance personnel, recording equipment to take material off the air or transmission lines, and television receivers. A rather high percentage of respondents indicated that they were not willing to invest any local funds in each of the technologies, with the items receiving the highest percentage of "none" answers being long distance transmission, software development, computer terminal rental, and antenna systems to receive signals. Slightly less than one-half of the respondents were willing to invest up to 25 percent of the cost of the following items from local funds: long distance transmission, antenna systems, systems to distribute signals throughout a building, computer terminal rental, printed instructional programs, and software development.

Cross-tabulations of these responses were prepared according to district size, ethnic/cultural characteristics of the district, community characteristics, and Regional Education Service Center number.

The cross-tabulation of size of district with the percentage of local funding which each district would be willing to supply indicated no appreciable differences among the various cost items listed on the questionnaire. The most noticeable difference was in the larger number of respondents from small districts indicating that they were willing to invest no local funds or less than 25 percent of local funds in the cost items. Respondents from large districts (over 50,000 ADA) and those from districts with ADA's between 10,000 and 50,000 showed more willingness to invest between 25 percent and 50 percent of local funds in most items.

A cross-tabulation was made between willingness to fund locally and the number of ethnic/cultural groups represented by a school district's constituency. The districts which had at least two, and often three or more, ethnic groups represented in their constituencies appeared to be more willing to invest up to 50 percent local funds in the cost of items such as long distance transmission, antenna systems, distribution systems within buildings, television receivers, computer terminals, and programmed instruction. Respondents from districts with only one ethnic group in their constituency tended to present very mixed responses, indicating, for example, willingness to invest quite heavily in recording equipment, software, and personnel for both utilization and maintenance, but less willingness to invest in other items.

Responses were also compared with community demographic characteristics. For long distance transmission costs, respondents from rural districts indicated willingness to expend under 25 percent local funds. More respondents from small towns indicated willingness to spend between 25 and 75 percent local funds to receive signals. For the building of antenna systems to receive off-air signals, suburban and urban districts indicated willingness to expend more local funds then any other type of district. Expenditure of local funds for installing electronic distribution systems within buildings received low willingness ratings from all respondents. At least 50 percent of all respondents, except for those from urban districts, indicated that they would be willing to spend no more than 25 percent local funds on purchasing television receivers. In general, respondents from districts of all sizes indicated low priority for computer terminal rental or lease, with 96 percent of the respondents from rural districts indicating that 25 percent of the cost was the maximum they would be willing to spend. One-third of the respondents (from all sizes of community) indicated that they would spend 25 to 50 percent of local funds for recording equipment to record information for later use. Apparently few of the respondents recognize the potential of this equipment for greatly expanding the learning resources available to students. Printed programmed instruction fared much better among respondents; 21.4 percent of them indicated that they would spend from 50 to 75 percent of the cost from local funds, although there was no clear-cut pattern by demographic characteristic of district.

Staffing, either with professional utilization specialists or with maintenance personnel, tended to follow the same general pattern in the ratio of state to local support; most respondents indicated willingness to spend up to 25 percent on staffing, and some were willing to go as high as 50 percent. Those willing to spend more local funds for staffing tended to be from suburban districts. Software development costs rated slightly better as a local expenditure item than did some other items. Twenty-three percent of the respondents from small cities indicated that they would be willing to invest 50 to 75 percent of local funds in software development.

Cross-tabulations of respondents' answers with Regional Education Service Center numbers produced no usable results because of the small sample size.

Economic characteristics of communities were also compared with expressed willingness of administrators to expend local funds for the same items. In general, industrial and agricultural communities tended to be willing to spend approximately 25 percent local monies on most items. College and university related communities appeared to be more willing to expend larger amounts of local monies on staffing and on software development, whereas respondents from industrial, agricultural, and commercial communities tended to favor local investment in more tangible items such as television receivers and programmed instruction in printed form.

Information Needs of Administrators

Overview. While the assumption may be made that administrators need all of the information about teaching processes, development, performance, and in-service that teachers need, there are also special administrative needs which might be met, in part, by a telecommunications system. Several types of information that could be supplied to administrators were therefore listed, and administrator respondents were asked to indicate for each type whether they felt an urgent need for it, felt a moderate need for it, felt that current information was adequate, felt that the information was not needed and possibly undesirable, or felt that the information was definitely not needed and highly undesirable. The responses are displayed in Table IV-t.

EXPRESSED INFORMATION NEEDS OF ADMINISTRATORS

	Urgent Need	Moderate Need	Adequate As Is	Not Needed	Highly Undesirable
Cost query	20.2%	51.9%	15.4%	9.6%	2.9%
Dissemination system	41.1	52.3	4.7	1.9	-0-
Awareness service literature	28.0	56.1	10.3	5.6	-0-
Awareness service opportunities	26.0	60.6	11.5	1.9	-0-
Current developments	35.5	54.2	8.4	1.9	-0-
Instructional materials	36.4	55.1	7.5	0.9	-0-
Developing technologies	33.0	57.5	9.4	-0-	-0-
Research summaries, theories, & concepts	31.7	56.7	11.5	-0-	-0-

Table IV-t

Detail. When the percentages of respondents who indicated that they had an urgent need and a moderate need for the suggested information are combined, it is clear that all items might serve to improve the information base from which administrators make decisions. The item on which most respondents felt no need for information was cost estimates for various goods and services, perhaps because of the currently unstable price structure of all goods and services. Areas in which they expressed greatest need were (1) dissemination programs to alert them to new policies and legislation; (2) a current awareness service to alert them to significant journal publications; and (3) a service to alert them to continuing education opportunities, developing technologies, new instructional materials, and research summaries of learning theories and concepts. In other words, they expressed a definite need for more efficient information reduction and dissemination than they currently have available. Implied in this need is that the dissemination be selective in terms of individual user profiles.

Cross-tabulations of responses were run on the administrative information needs together with size of district and community characteristics.

Cross-tabulation of size of school district with administrators' perceptions of their information needs produced no clear-cut results. A pattern that did seem to emerge was that administrators in the largest districts (over 50,000) tended to see a more urgent need for the information systems suggested in the questionnaire, while those in districts with ADA's between 1,500 and 5,000 seemed to see the least need for such information. One interesting result was that almost all administrators in all sizes of districts indicated either an urgent or a moderate need for information about developing technologies. Since this question appeared at the end of the questionnaire, responses may have been patterned somewhat by the questions which the respondent had answered previously; however, another possible reason for such a marked indication of need for information about developing technologies is that administrators are indeed aware of the galloping pace at which technologies change, and may feel that this rapid pace deters decision-making because they are not aware of future developments which may affect the usefulness of current technologies.

When community demographic characteristics were compared with respondents' expressed needs for information, respondents from rural communities generally evinced a greater need for information than did other respondents; on information about policies and legislation, 100 percent of the respondents from rural communities indicated a need for additional and current information. Respondents from urban districts joined those from rural districts in indicating that they needed a great deal more information on curricular developments and on instructional materials.

Comparison of economic characteristics with respondents' expressed needs for information showed relatively few differences among respondents from communities of different types, and none that were marked.

Further cross-tabulation of responses with type of administrative position that respondents held showed that district level administrators expressed a far greater need for cost information than did other administrators. District level curriculum and supervisory personnel expressed the lowest levels of need for information on developing technologies and on learning theories and concepts, conceivably because they see themselves as already cognizant of this facet of education.

SUMMARY REMARKS

The reader of this chapter should again be reminded to view its findings with some reservations, both because of the small sample used and because of the acceptable but not impressive rate of response (33 percent); the relatively small proportion of responses from teachers should also caution against broad extrapolation of findings. Finally, it should be noted that when respondents completed the survey instrument and returned it, the state legislature was in session and appeared to be considering several different school finance reform proposals, leaving respondents almost completely "in the dark" about what to expect with regard to state support of education in the coming biennium.

Information Needs

From the responses of both teachers and administrators, it is clear that any proposed telecommunications system needs to take into account the information needs of professional personnel concerning educational trends and developments, performance of teaching tasks, specific instructional processes, and methodologies and materials to be used in teaching content subjects. Over 80 percent of administrator respondents also expressed needs for updating information to aid them in administrative decision-making. A question not explored in this survey, but one which should be given careful consideration, is the degree of information reduction desired by educators and how easy it should be for them to obtain further information on any given topic.

Attitudes Toward Technology

Both teachers and administrators expressed more favorable attitudes toward those technologies with which they were conversant or which did not appear to be complicated, but administrators were more willing to entertain the use of more complex, sophisticated technologies.

Support for Educational Technology

Slightly under 50 percent of both teachers and administrators thought that parents and school boards would support many of the technologies suggested, whereas 20 to 50 percent of the respondents thought that parents and board members would oppose the technologies' introduction into schools on a basis of local funding. With state funding, the indications of support were much higher.

Administrators showed reticence to finance a large percentage of educational technologies from local sources; again, the reader is asked to remember that the questionnaire went out during a legislative session considering school finance reform.

Effect of Technology on Other Educational Subsystems

According to respondents, the use of educational technology would seem to require a number of support personnel, including (1) learning resource specialists to assist with utilization of technologies, (2) maintenance specialists, and (3) production assistants.

A large percentage of respondents thought that educational technology increased teaching/learning effectiveness and freed the teacher for work with individual students. A similarly large percentage did not feel that the use of mediated technologies caused the teacher to lose control either of timing or of content being taught.

Use of Technology in In-Service Training

Respondents indicated greater willingness to use the more familiar technologies for in-service training on their own time, whereas they wanted use of the more complex technologies such as computers, facsimile reproduction, and two-way, interactive systems to be done on a released time basis.

Overall, attitudes toward the use of technology to meet teacher needs were more positive than negative. The expression of need from both teachers and administrators for information and continuing education was staggeringly high, and should be given high priority in any instructional resources system. There appears to be a general climate of acceptance, with some honest reservations, and a genuine desire on the part of professional personnel who responded to the survey to continue to learn.

Application of Survey Findings

The overall findings of this survey were intended to be, and are in fact, a main pillar in the solution structuring of this study. Further use of these results will be found in Chapter IX, dealing with alternative solutions.

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V

existing nets

PRÉCIS

This chapter examines all the networks in Texas which could be identified and that might be useful, either wholly or in part, for purposes of educational technology. These nets are examined in terms of users, type of traffic, switching (if any), and traffic loading.

The opening section gives an overview and some definitions. The next section examines the nets, including discussion of twelve separate networks or systems. One of these discussions, on library networks, itself includes 14 separate nets designed for different purposes but all involved in educational endeavors (although many are in higher education).

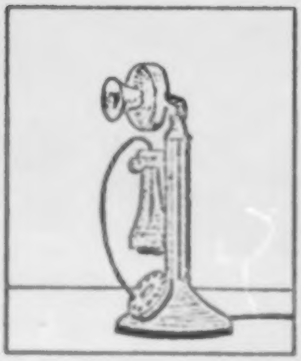
The next section treats the legislative aspects of the telecommunications functions, including a discussion of prior efforts as well as the status of some relevant legislation. Several Texas bills are identified and explained and their current status indicated.

Implications of all the existing nets are enumerated and discussed. The existing telephone and data nets are deemed significant for educational purposes, and the extensive CATV capability in Texas is also considered important.

The chapter contents are:

General p. V-1
Networks (including library networks) p. V-2
Legislative Aspects p. V-21
Implications p. V-40
Bibliography p. V-42

(See also Appendices Charlie and Delta)



V

EXISTING TEXAS NETWORKS

GENERAL

This chapter focuses specifically on educational telecommunications resources already existing within the state of Texas, and it broadens in scope to encompass more of the field of educational technology, from the facilitation of human learning to systems engineering of instructional resources and the management thereof. The methodology employed in gathering this information has included contact with vendors, federal and state agencies, and professional and technical societies, as well as the use of both manual and automated library search and retrieval systems, such as ERIC.

Various technologies which are integral to and/or on occasion require the use of telecommunications networks are included within the scope of this study because telecommunications alone represents one link in the chain of a total instructional resource data base. The role played by the telecommunications network is that of a delivery system, with the various "nodes" or exchanges representing input, output, and transfer points that create a more even flow of information. This information may pertain to instructional content within an educational system, or it may relate to some function of a particular administrative process. Whichever role it performs, the content is generated outside the telecommunications network and the information is ultimately used in activities which are also wholly outside the network.

Telecommunications technology has great potential for improving both the quantity and the quality of education, particularly in the areas of computerized information storage and retrieval, computer-managed instruction, video projection techniques for auditorium-sized classes, and handling of great masses of information that can be digitalized. However, a distinct division exists between this technology and its users in the field of education. Telecommunications networks can handle information or media to or from any agency; they are not specifically concerned with content, but rather with the competency which ensures that the content arrives rapidly, accurately, and intact--whether it be writing, images, sounds, or decipherable intelligence. In order for a telecommunications network to be at its most efficient, the content should be made congruent with the technology, and the symbiotic relationship between the system and the educator who uses it must be fully understood for successful implementation.

Fortunately, telecommunications technology is sufficiently advanced that a wide spectrum of solutions is available to educators with specific problems to be solved. These technological solutions can be tailored to meet the unique requirements of large and small school systems, urban and rural environments, and various ethnic mixtures. However, in order to implement any solution successfully, the educator must be able to understand both the technology and the system it comprises, to use them efficiently and pragmatically, and to avoid being bogged down in technical details and ramifications. Otherwise, the wealth of knowledge available will be but an embarrassment of riches, and lack of comprehension will preclude the introduction of any innovative solutions at all. This situation can be averted only through a process of definition, clarification, and amplification of terms and procedures. To this end, and to place this section of the study in perspective, we shall begin by defining the term network, as used herein, with telecommunications:

> A network is a system of locations interconnected by communications channels. In telephone communications, a switched network is a network of telephone lines using dialed telephone links, whereas a private line network is a closed network of communications channels confined to the use of one customer or hierarchy for communication to one or more other customers. While there are many types of networks other than telephone (digital, video, facsimile, telegraph, AM/FM radio, telex, etc.), the above definition has been selected as a basic reference point for the study of existing educational telecommunications networks in Texas. (Educational Development Corp., 1975)

The Texas telecommunications assessment comprising the remainder of the chapter consists of an examination of each of the various networks: its nature, participants, purpose, functions, and potentialities. Some few Texas networks are omitted from the discussion, either because they would have no accessibility and hence no utility to other organizations (for example, the Department of Public Safety network, which operates on a confidential, intradepartmental basis), or because they are minor and/or fragmented and do not merit further consideration. The major networks having potential for expansion or shared use are examined in some depth, and the alternatives are compared on the broad bases of costs, compatibility, further growth potential, and legal factors.

NETWORKS

The existing telecommunications base in the state of Texas comprises a vast number of diverse network resources, including commercial television broadcast stations, state-owned educational television stations, community antenna (cable) television services, closed circuit television, instructional television fixed service, library information handling networks, networks for computer-assisted instruction, a dedicated switched state telephone network, and an educational management information handling system.

Greenberger et al. (1974) provide a listing of nine major potential uses or applications of computer networks, interpreted herein within the broader context of telecommunications, as follows:

(1) Administrative
(2) Instructional
(3) Educational development and testing
(4) Computation
(5) Library information storage and retrieval
(6) Data processing
(7) Management information systems
(8) Communications (store and forward telephony and data switches)
(9) Laboratory control and data acquisition

Figures V-A and V-B represent an effort to categorize existing state telecommunications resources according to type and use of network, respectively. Where multiple uses exist, this is so indicated. In Figure V-B, where the matrix adheres to the Greenberger listing, a tenth category has been added to cover the commercial uses of telecommunications, such as commercial television stations and cable systems. These figures indicate a wide variety of applications, with compatibility limited primarily to technical areas such as voice frequency transmission, data transmission, and video transmission.

TAGER

The Association for Graduate Education and Research of North Texas (TAGER) is a non-profit educational organization chartered in August, 1965, and headquartered at Southern Methodist University in Dallas. It operates a multichannel closed circuit microwave television system linking a number of institutions of higher learning and industrial organizations in

TEXAS EDUCATIONAL COMMUNICATIONS NETWORKS ACCORDING TO USE OR APPLICATION

APPLICATION NETWORK	Administrative	Instructional	Educational Development and Testing	Computation	Library Information Storage and Retrieval	Data Processing	Management Information Systems	Communications	Laboratory Control and Data Acquisition	Entertainment and News
TAGER		X	X							
TEMP		X						X		X
Texas Telecomputer Grid		X	X				X	X	X	X
Educational ITFS (2500 MHz) Stations		X	X							X
Educational FM Radio Stations		X								X
UHF and VHF Educational TV Stations		X								X
Library Storage and Retrieval Networks	X				X		X	X	X	
Closed Circuit TV Networks		X	X							X
TEX-AN	X							X	X	
Texas Education Agency: Office of Management Information	X	X		X	X	X	X		X	
Education Service Center Network	X	X	X	X	X	X	X		X	
Computer Networks: CONDUIT		X	X	X	X	X		X		
Satellite Linked Networks		X	X		X			X	X	

Figure V-A

TEXAS EDUCATIONAL COMMUNICATIONS NETWORKS
ACCORDING TO CATEGORY OR TYPE

NETWORK / CATEGORY OF TELECOMMUNICATIONS	Computer-assisted Instruction	Commercial TV Broadcast	FM Broadcast	Cable and Closed Circuit TV (CATV)	ITFS (2500 MHz)	Satellite	Mobile Radio	Dedicated Telephone Network
TAGER					X			
TEMP				X	X			
Texas Telecomputer Grid	X				X			
Educational ITFS (2500 MHz) Stations					X			
Educational FM Radio Stations			X				X	
UHF and VHF Educational TV Stations		X					X	
Library Storage and Retrieval Networks								X
Closed Circuit TV Networks				X	X			
TEX-AN								X
Texas Education Agency: Office of Management Information	X							
Education Service Center Network	X							
Computer Networks: CONDUIT	X							
Satellite Linked Networks						X		

Figure V-B

North Texas, primarily Dallas and Fort Worth. (See Figure V-C.) The system is an interactive one, with telephones and voice grade answerback lines at each participating site that are patched back to the site initiating a broadcast, thus allowing two-way conversation during live one-way videocasting. In all, six TV channels are involved, with an average of three to four channels normally used throughout the year.

Nine educational institutions and eight commercial corporations are currently participating in TAGER. Although the principal source of broadcast material is Southern Methodist University, broadcasts may be originated from live classes conducted at any one of the colleges or universities, all of which are equipped with studios; the industrial sites have receive-only facilities. The system, originally financed by a research grant from the federal government, is now self-supporting, although some industrial sponsors are discontinuing participation because of present economic conditions, and maintenance and operating costs are increasing as a result of the energy crisis.

The purposes of the organization are to provide the necessary competency to develop cooperative instructional programs between participating institutions; and to improve the quality of higher education in North Texas by providing more avenues of access to greater numbers of students through more efficient utilization of instructional resources and faculties via microwave television. The system has offered 1,132 courses to date, with a total enrollment of approximately 25,591 students at the nine campuses and seven industrial plants in the Dallas-Fort Worth area. Offerings for the 1975 school year include 95 additional courses for presentation to some 1,600 students. The curriculum, designed to meet the high technological demands of the Dallas-Fort Worth industrial complex, includes a high percentage of engineering, science, mathematics, and business courses, many at the graduate level. Undergraduate and some graduate courses are also offered in English, foreign languages, anthropology, theology, history, political science, sociology, speech, education, economics, statistics, biology, chemistry, and physics. For the 1975-76 school year, the system additionally plans to offer computer science and classics courses. Participants may register as full-enrollment students or as auditors; the cost for a three-hour course is $300 for full enrollment or $50 for auditing.

Future expansion could involve the installation of a channel expander to provide data under voice capability and the use of a computer for on-line storage of answers and records during interactive student use. Response would be via teleprinters or cathode ray tube displays, which could provide a more precise input to the computer for record keeping and student answer processing. Constraints on such expansion would be the additional costs for a computer, a multiplexer, and terminals, assuming that channel derivation equipment will be available to provide for as many as 128 multiplexed voice bandwidth half duplex circuits. This additional capability would provide a more flexible on-line system than presently exists with the live videocasting, and would reduce administrative costs for testing, record keeping, etc. However, as of this writing, no plans for expansion or updating of the system have been finalized, although existing equipment is nearly ten years old and becoming obsolescent.

In summary, the TAGER system is the largest and probably the most efficient of the Texas instructional television fixed service networks. Response of the faculty and students involved has been overwhelmingly favorable. However, as previously indicated, the network is facing the problem of obsolescence because it lacks capabilities other than television broadcasting. Multi-purpose video and data systems are now in use elsewhere in the state (e.g., the Texas Telecomputer Grid System of Central Texas College), and a further study of future technical requirements for TAGER is now in order. In terms of cost analysis, TAGER is slightly more expensive than traditional instruction because of the cost of the plant operating system, which must be maintained at a high degree of efficiency whether in use or not. The transmission network was built, essentially, with a personal gift of $1,000,000 from a Dallas couple; each of the four studio classrooms at Southern Methodist University (SMU) cost approximately $60,000 to set up and equip. At industrial sites, to install one receiving classroom with the equipment necessary for one-channel reception costs approximately $40,000; each additional channel and classroom incurs

TAGER SYSTEM

In order that the magnitude of the TAGER System might be shown in its proper perspective, the following geographical representation is presented.

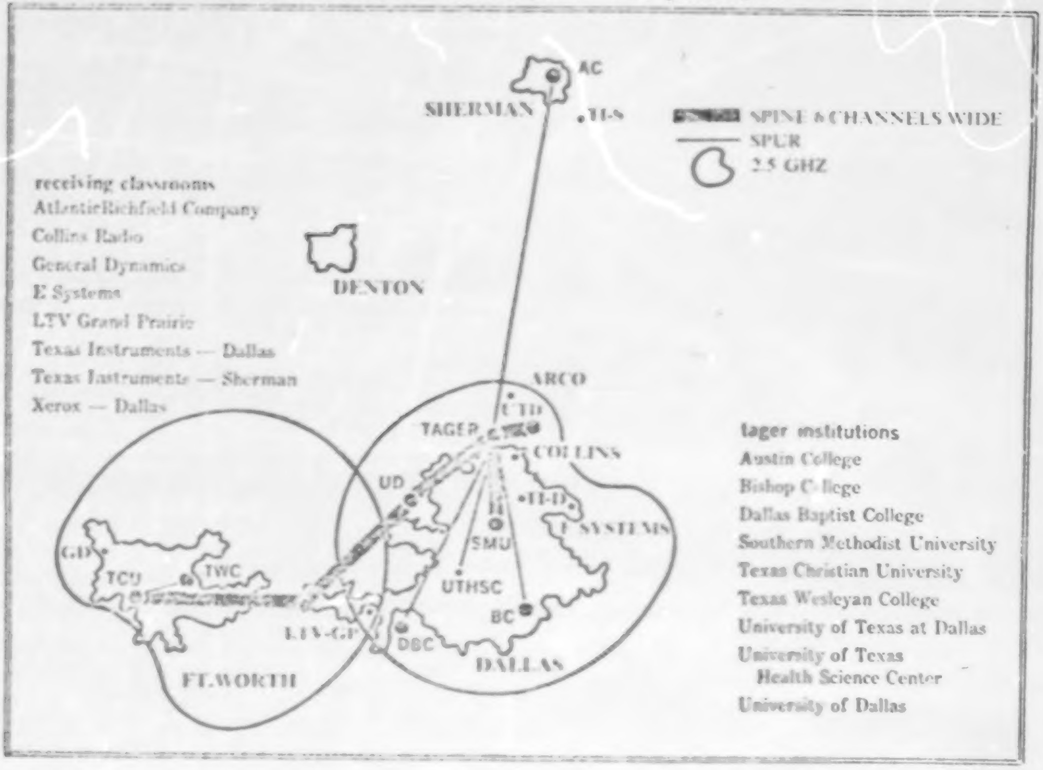

AC
SHERMAN
TI-S
SPINE 6 CHANNELS WIDE
SPUR
2.5 GHZ
receiving classrooms
AtlanticRichfield Company
Collins Radio
General Dynamics
E Systems
LTV Grand Prairie
Texas Instruments — Dallas
Texas Instruments — Sherman
Xerox — Dallas
DENTON
ARCO
UTD
TAGER
COLLINS
UD
TI-D
E SYSTEMS
SMU
GD
TCU
TWC
UTHSC
BC
LTV-GP
DBC
DALLAS
FT.WORTH
tager institutions
Austin College
Bishop College
Dallas Baptist College
Southern Methodist University
Texas Christian University
Texas Wesleyan College
University of Texas at Dallas
University of Texas Health Science Center
University of Dallas

Figure V-C

costs of about $20,000. Staff and maintenance costs are shared by participating institutions on the basis of relative use, with the biggest user, SMU, spending approximately $30,000 per year. Cost problems, as mentioned, are presently exacerbated because of the current economic situation, which has forced many defense-oriented institutional subscribers to cut back on or eliminate tuition payments for their employees. This, in turn, has raised overhead and operating costs for the universities that constitute the backbone of system support.

TEMP

The Texas Educational Media Program (TEMP), a non-profit corporation now dependent upon contributions from members and foundation grant funds, was organized in 1961 as the Texas Educational Microwave Project through a grant from the Department of Health, Education, and Welfare to the University of Texas. Physically housed in the new School of Communication building on the University's Austin campus, alongside the educational VHF television station KLRN (Channel 9), TEMP is managed by the UT Department of Radio/Television/Film as a part of its academic facilities. The station is staffed by a small group of permanent professionals, and is considered one of the finest and most efficient educational telecommunications operations in the state.

TEMP provides programs through closed circuit television (coaxial cable and microwave relay) to three state-supported junior and senior colleges and five private senior colleges in the Austin-San Marcos-San Antonio area. (See Figure V-D.) While most TEMP transmission comprises instructional television programs, there has also been some use of the microwave system for a small amount of digital data. The network presently comprises eight colleges and universities in Austin, San Antonio, and San Marcos; any other institution of higher education in this geographic area that can install the necessary microwave equipment and make annual contributions (assessed by enrollment formula) to operating costs is also eligible to join the system.

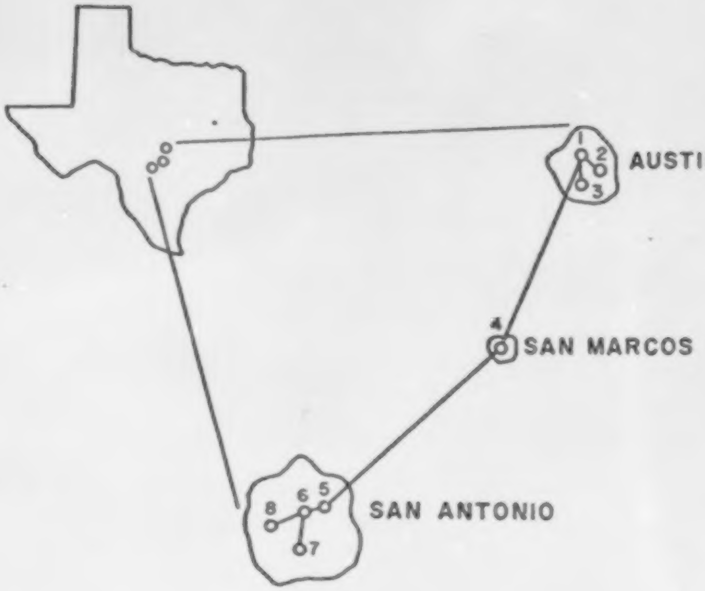
The purposes of TEMP are severalfold: to share faculty resources among the member institutions; to provide audiovisual stimuli which are not readily available to the classroom instructor; to produce televised materials which are designed to meet the individual needs of colleges and universities in the region; and to provide coursework support for member institutions lacking strong resources in particular academic areas.

TEMP transmits scheduled broadcasts from the Communication Center at the University of Texas, Austin, simultaneously to all members. Programming emphasis has recently shifted from complete televised courses to the use of the medium as a supplement to regular classroom instruction. Monthly program guides are issued to all users, and only those programs requested by instructors are actually aired, in order to save wear and tear on the system. A cross-reference file made up from the catalogs of universities and film or tape libraries across the country, comprising over seventy main subject headings, helps users locate supplementary programs produced elsewhere. Materials requested--generally 2-inch video tapes--are ordered by the Austin headquarters and broadcast to the requesting institution.

Program offerings for the 1973-74 school year included broadcasts in the areas of anthropology, business, ecology, education, ethnic studies, history/political science, journalism, language, literature/English/speech, music/art/drama, philosophy, public affairs, science, sociology/psychology, and other, miscellaneous topics. A total of 720 hours (1,958 feeds) were broadcast, including use of a video cassette machine for playbacks in classrooms on the University of Texas campus. The operating budget for fiscal year 1974 was $73,474.

TEMP tentatively plans to merge with TEKNET, if and when the latter is funded and made operational, for sharing of resources among the publicly-supported institutions of higher education in Central and South Texas. (See material on TEKNET, page V-27.) Future considerations will need to take into account the growing obsolescence of some of the microwave equipment, which no systematic planning effort has yet been launched to obviate.

TEXAS EDUCATIONAL MEDIA PROGRAM (TEMP)


1
2
3
AUSTIN
4
SAN MARCOS
8
6
5
7
SAN ANTONIO

1. The University of Texas, Austin
2. St. Edward's University
3. Huston-Tillotson College
4. Southwest Texas State University
5. Trinity University
6. San Antonio College
7. Our Lady of the Lake College
8. St. Mary's University

Figure V-D

The Texas Telecomputer Grid Project

The Telecomputer Grid initiated in 1973 by Central Texas College, Killeen, Texas, is an instructional television fixed service network operating in the 2500 MHz frequency range and integrating a variety of telecommunications components. (The term telecommunications here includes audio communications, data communications, computer transmission, and television.) Telecasts may be made from any point on the network to all other points; two television channels and up to four audio channels are capable of operating simultaneously. The network is only partially operational at this time, with completion anticipated in 1976.

Participants in the network are shown in Figure V-E, with the status of the individual links varying widely. The facilities in Killeen, Fort Worth, and Dallas are nearly operational. In San Antonio, the studio has been completed and hooked into the Telecomputer Grid system; it is expected to become operational around July, 1975. The Texas Education Agency studio, located in the facilities of the Southwest Educational Development Laboratory in Austin, is also expected to be operational some time in 1975. The Federal Communications Commission has issued a permit to extend the Telecomputer Grid to Houston via Conroe and establish a studio in the Region IV Education Service Center, located in the Hancock Center. Finally, additional proposals have been submitted to the Texas Education Agency for providing a digital data transmission capability to the Richardson and San Antonio nodes of the Grid. At present, the transmission quality of the system is somewhat substandard, and the system operation is still subject to frequent failures. Data communications lines apparently are not of the high quality circuit that provides a minimum error transmission rate, and the circuits themselves are not in the class 4B or 4C conditioned data circuit category, which is required for medium and high speed data rates.

Distribution of programming and data to system users may be accomplished by cable in areas of population concentration; by dropping video and data channels, with subsequent distribution by cable if necessary, to populations in the vicinity of microwave repeater stations; and in some cases by subsidiary microwave shots to outlying users. The system is designed to: (1) interconnect the central offices of participating institutions in order to transfer current information for use in planning, evaluation, and reporting; (2) provide duplex picture and audio transmission capabilities for teacher training, dissemination of information, and instructional purposes; and (3) combine data and television capabilities in computer-assisted instruction, televised instruction, etc. The system is scheduled to be tested in the general application areas of management, library resource retrieval, television, computer, and telecomputer.

Recent pilot projects in Fort Worth and Dallas have involved an in-service training seminar for teachers on drug education, and the provision of classroom instruction on career education through use of a remote computer. The evaluation of these projects, while noting the development of a master plan in telecommunications for the Dallas-Fort Worth area, does not specify the potential role of the Telecomputer Grid in such a plan (Gebolys, 1974).

Recently, the system was used to telecast eight one-hour in-service programs, explaining the rationale for and teaching techniques of career education, to approximately 80 elementary school teachers in Dallas, Fort Worth, Killeen, and San Antonio. In this project, known as Project INTERACT, participants viewed the programming and were given the opportunity to respond to it via the Telecomputer Grid. Evaluation of the programming, teacher responses to it, its influence on students, use of the telecommunications medium, and follow-up were to be completed by July, 1975.

Other ITFS Stations

Several other educational Instructional Television Fixed Service (2500 MHz) stations are now operating in Texas or have received permits to operate, as shown to follow, on page V-11. These are, for the most part, operated by school districts. (See Figure V-F.)

TEXAS TELECOMPUTER GRID

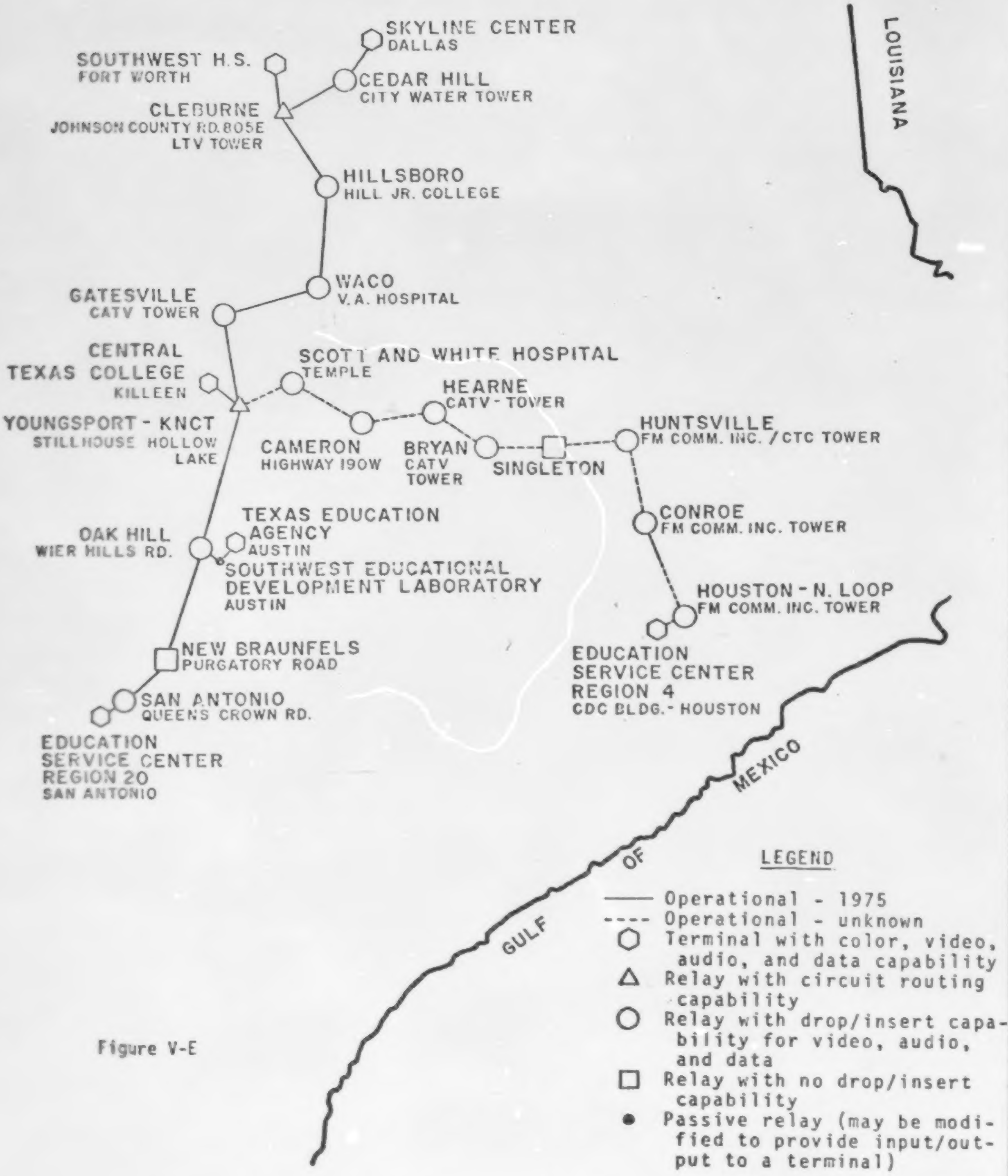

SKYLINE CENTER
DALLAS
SOUTHWEST H.S.
FORT WORTH
CEDAR HILL
CITY WATER TOWER
CLEBURNE
JOHNSON COUNTY RD.805E
LTV TOWER
HILLSBORO
HILL JR. COLLEGE
WACO
V.A. HOSPITAL
GATESVILLE
CATV TOWER
CENTRAL
TEXAS COLLEGE
KILLEEN
SCOTT AND WHITE HOSPITAL
TEMPLE
HEARNE
CATV - TOWER
YOUNGSPORT - KNCT
STILLHOUSE HOLLOW
LAKE
CAMERON
HIGHWAY 190W
BRYAN
CATV
TOWER
SINGLETON
HUNTSVILLE
FM COMM. INC. / CTC TOWER
CONROE
FM COMM. INC. TOWER
TEXAS EDUCATION
AGENCY
AUSTIN
OAK HILL
WIER HILLS RD.
SOUTHWEST EDUCATIONAL
DEVELOPMENT LABORATORY
AUSTIN
HOUSTON - N. LOOP
FM COMM. INC. TOWER
EDUCATION
SERVICE CENTER
REGION 4
CDC BLDG. - HOUSTON
NEW BRAUNFELS
PURGATORY ROAD
SAN ANTONIO
QUEENS CROWN RD.
EDUCATION
SERVICE CENTER
REGION 20
SAN ANTONIO
LOUISIANA
GULF OF MEXICO
LEGEND
—— Operational - 1975
---- Operational - unknown
⬡ Terminal with color, video, audio, and data capability
△ Relay with circuit routing capability
○ Relay with drop/insert capability for video, audio, and data
□ Relay with no drop/insert capability
● Passive relay (may be modified to provide input/output to a terminal)

Figure V-E

Call Sign	Channel	Licensee	Key Personnel	ADA
KRZ	68	Spring Branch ISD 955 Campbell Road Houston, Texas 77024 (713) 464-1511	Dr. H. H. Landrum, Superintendent Henry L. Thomas, TV Instructor	35,399
WAU	31	University of Texas Graduate School of Biomedical Sciences UT Health Sciences Center P. O. Box 20367 Houston, Texas 77025	Dr. Grant Taylor	
KHS	78	Mesquite ISD 405 East Davis Mesquite, Texas 75149 (214) 285-6351	Dr. Ralph Poteet, Superintendent James Frehner, Director of ITFS	16,985
KHS	77	Edgewood ISD 6458 West Commerce San Antonio, Texas 78237 (512) 433-2361	Bennie F. Steinhauser, Superintendent	20,223
WEF	69	Richardson ISD 400 South Greenville Richardson, Texas 75080 (214) 235-7770	J. J. Pearce, Superintendent H. H. Bobele, Director ITV	29,866
KHU*	92	Brazosport ISD Drawer Z Freeport, Texas 77541 (713) 233-3581 *station operation undergoing change	H. K. Wilson, Superintendent Dr. Cecelia Blackstock, Director of TV	9,827

Call Sign	Channel	Permittee	Key Personnel
WPB	71	Dallas ISD 3700 Ross Avenue Dallas, Texas 75204	
KWU	29	(Fort Worth-TAGER) Association for Graduate Education and Research of North Texas Box 30365 Dallas, Texas 75230	Robert Olson
KWU	30	(Richardson-TAGER) Association for Graduate Education and Research of North Texas Box 30365 Dallas, Texas 75230	Robert Olson

Problems faced by the ITFS stations include increasing costs of production or replication of software; lack of standards for software evaluation (the tendency is to use National Instructional Television Service or Public Broadcasting Service materials, obtained through consortium purchase and aired without questioning their appropriateness or efficacy); lack

OTHER ITFS STATIONS

2500 MHz

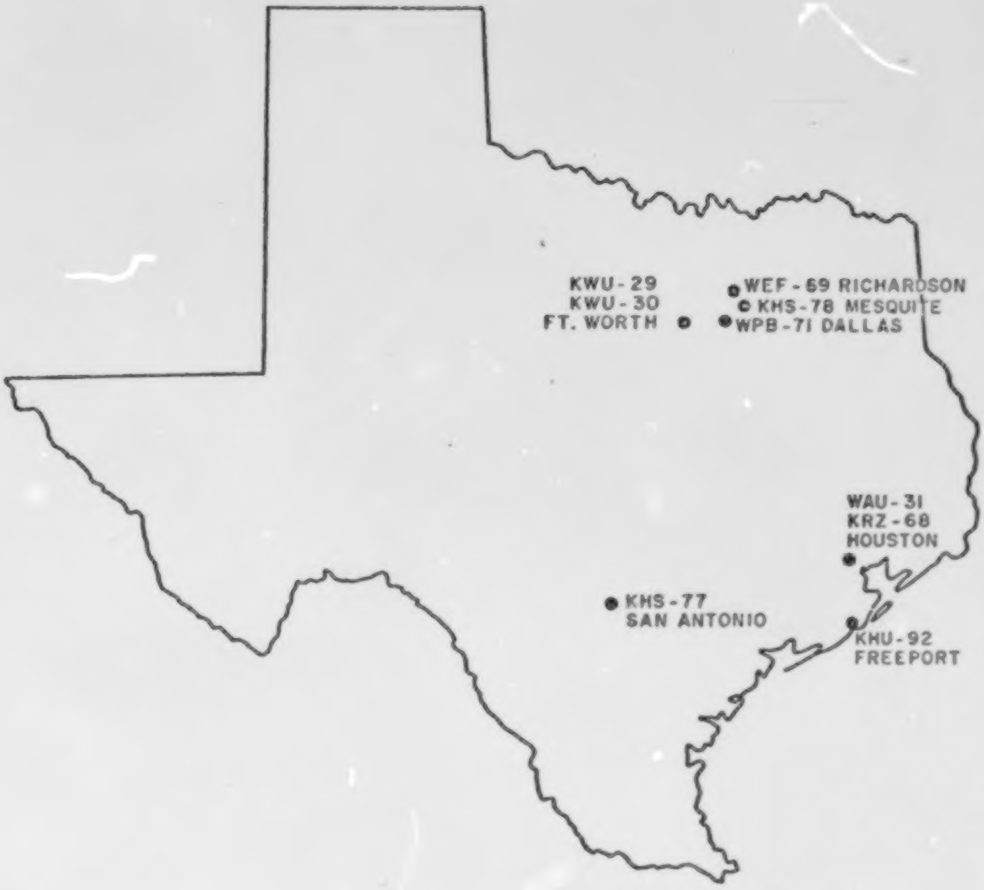

KWU-29
KWU-30
FT. WORTH
WEF-69 RICHARDSON
KHS-78 MESQUITE
WPB-71 DALLAS
WAU-31
KRZ-68
HOUSTON
KHS-77
SAN ANTONIO
KHU-92
FREEPORT

Figure V-F

of central production facilities for televised materials; maintenance difficulties with old video tape recording equipment; difficulty of dissemination of recorded media; and competition among stations for available funds.

UHF and VHF Educational Television Stations

Those stations now operating in Texas are shown in Figure V-G and indicated on the list below.

Station	Licensee	Ownership
KNCT (Belton, Channel 46)	Central Texas College Highway 190 West Killeen, Texas 76541	State institution
KAMU-TV (College Station, Channel 15)	Texas A&M University College Station, Texas 77843	Texas A&M University
KEDT (Corpus Christi, Channel 16)	South Texas Educational Broadcasting Council P. O. Box 416 Corpus Christi, Texas 78403	Non-profit organization
KERA-TV (Dallas, Channel 13)	Public Communication Foundation for North Texas 3300 Harry Hines Blvd. Dallas, Texas 75201	Non-profit educational organization
KUHT (Houston, Channel 8)	University of Houston 4513 Cullen Blvd. Houston, Texas 77004	University of Houston
KTXT-TV (Lubbock, Channel 5)	Texas Tech University Tech Station, Box 4359 Lubbock, Texas 79409	State institution
KLRN-TV (San Antonio-Austin, Channel 9)	Southwest Texas Public Broadcasting Council University Station, Box 7158 Austin, Texas 78712	Southwest Texas Public Broadcasting Council (non-profit organization)
KIDZ-TV (Wichita Falls, Channel 24)	Wichita Falls Educational Translator, Inc. c/o Ray Farabee 816 7th Street, Box 5147 Wichita Falls, Texas 76307	Private

As can be seen, many of these stations are associated with colleges or universities and thus are operated primarily to benefit these institutions, although some portion of their programming may reach the general public.

FM Radio Stations

Public broadcasting radio stations in Texas, all FM, are shown on pages V-15 and V-16. to follow. (See Figure V-H.)

EDUCATIONAL TV IN TEXAS: VHF-UHF

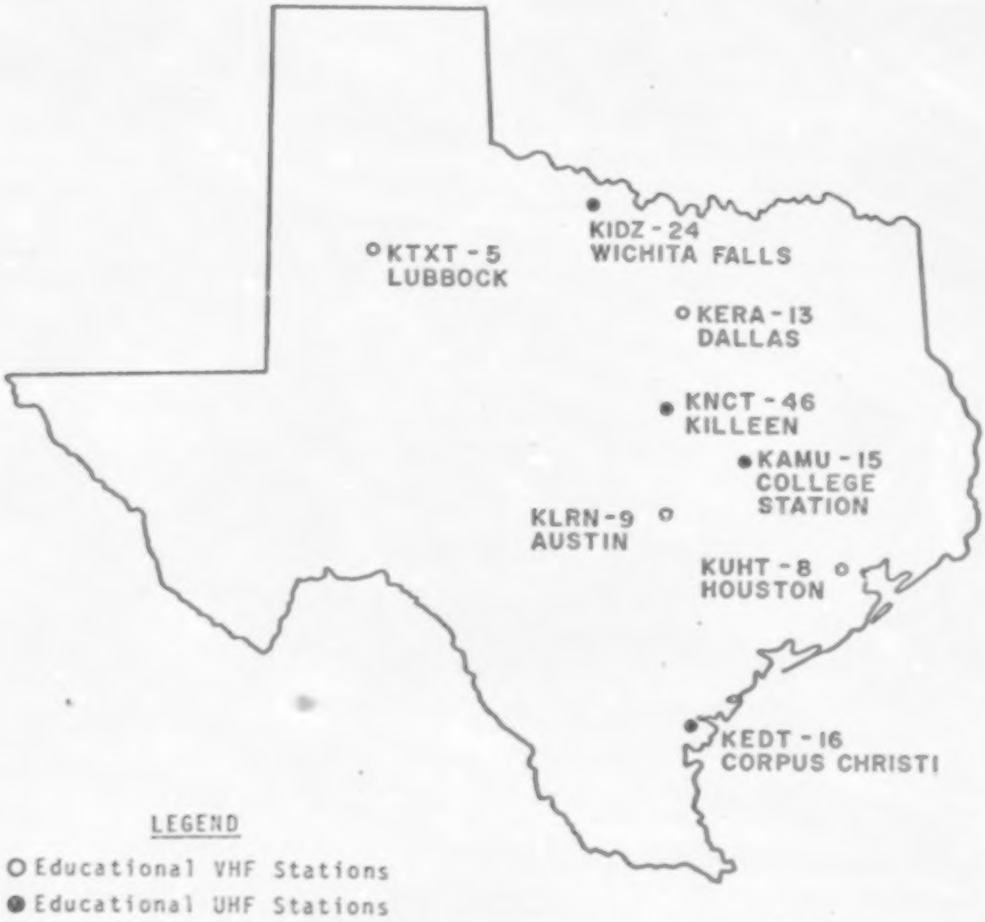

KIDZ-24
WICHITA FALLS
KTXT-5
LUBBOCK
KERA-13
DALLAS
KNCT-46
KILLEEN
KAMU-15
COLLEGE STATION
KLRN-9
AUSTIN
KUHT-8
HOUSTON
KEDT-16
CORPUS CHRISTI
LEGEND
○ Educational VHF Stations
● Educational UHF Stations

Figure V-G

Call Sign	Location	Station Manager/Director
KMFA-Austin	1014 Perry Brooks Building Austin, Texas 78701 (512) 472-1572	Kenneth W. Byrd
KUT-Austin	Communication Center University of Texas P. O. Box 7158 Austin, Texas 78712 (512) 471-1631	William S. Giorda
KWTS-Canyon	Department of Speech West Texas State University Canyon, Texas 79016	
KGCC-Denison	Grayson County College P. O. Box 909 Denison, Texas 75020 (214) 465-9003	Tom E. Spellman
KNTU-Denton	North Texas State University Denton, Texas 76023 (817) 788-2502	Edwin L. Glick
KTEP-El Paso	Mass Communications University of Texas at El Paso Box 328 El Paso, Texas 79968 (915) 747-5152	Louis Valles, Operations Manager
KTCU-Fort Worth	Texas Christian University University Drive Fort Worth, Texas 76129 (817) 926-2461	R. C. Norms
KPFT-Houston	618 Prairie Houston, Texas 77002 (713) 224-4000	Lawrence Yurdin
KTRU-Houston	Rice University Houston, Texas 77001 (713) 528-4126 x 1263	L. John Doerr
KUHF-Houston	University of Houston 226E/3801 Cullen Blvd. Houston, Texas 77004	Arvil Cochran
KNCT-Killeen	Central Texas College Highway 190 West Killeen, Texas 76541 (817) 526-1211	Richard D. Wilson
KTAI-Kingsville	Texas A&I University Station 1, Box 2271 Kingsville, Texas 78363 (512) 595-3402	Delbert Seese

Call Sign	Location	Station Manager/Director
KLSD-Lubbock	Monterey High School 3233 47th Street Lubbock, Texas 79413	C. Wilson
KTXT-Lubbock	Texas Tech University P. O. Box 4080 Lubbock, Texas 79409 (806) 742-6276	Clive J. Kinghorn
KOCV-Odessa	Odessa College Box 3752 Odessa, Texas 79760 (915) 337-5381	Wallace R. Jackson
KSYM-San Antonio	San Antonio College 1300 San Pedro Ave. San Antonio, Texas 78284 (512) 734-7311 x 391	Jean M. Longwith
KWBU-Waco	Baylor University Waco, Texas 76703	Joseph C. Walters

In summary, there are 17 FM radio stations in Texas which are involved in educational broadcasting. These include 14 college or university-operated stations, one high school-operated station, and two non-profit public broadcasting stations (KMFA in Austin and KPFT in Houston). As a general rule, the FM stations are operated in common facilities with educational television stations--KNCT-FM with KNCT-46 TV, KUT-FM with KLRN-9 TV, etc.

Cable and Closed Circuit Television

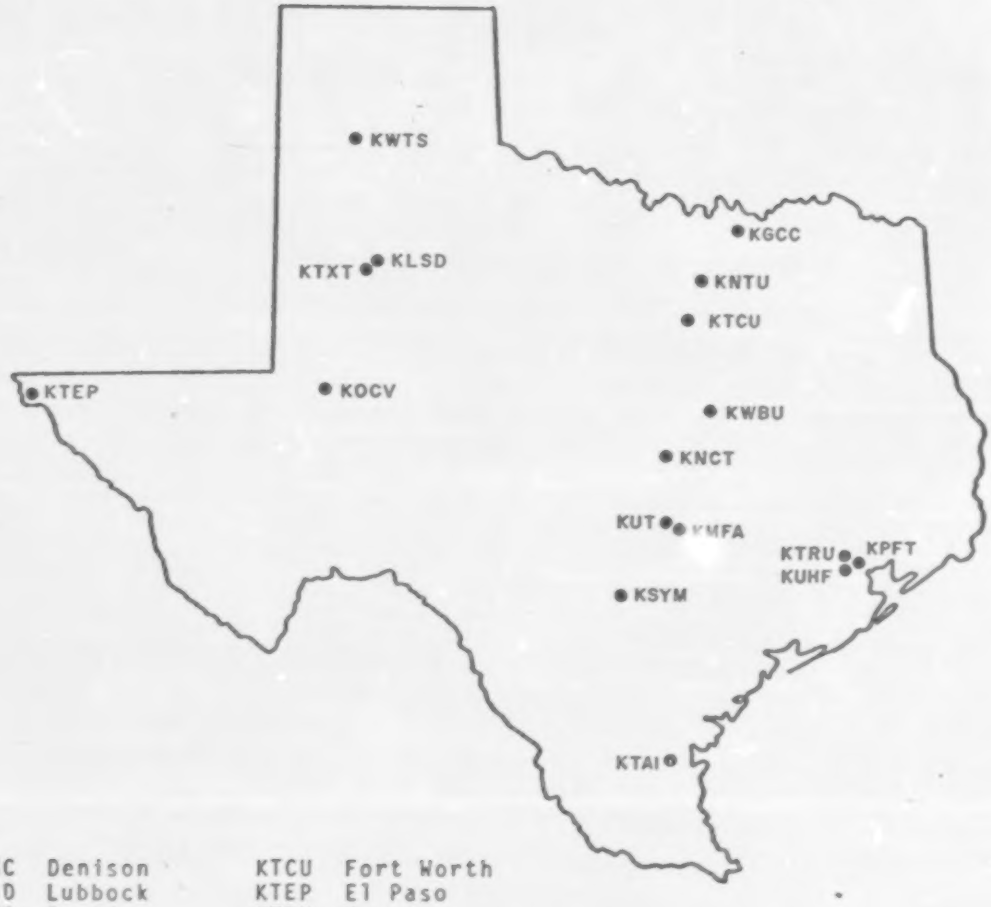
Educational. A number of school districts and individual schools throughout the state provide educational programs to their students through internal closed circuit television or cable television (CATV) facilities. Specific information on these activities is difficult to obtain without some prior knowledge of their existence; that which has been compiled in Figure V-I comes from the 1974 Television Factbook and from correspondence with schools listed as having closed circuit and/or cable facilities in information provided by the Texas Educational Television Association. Locations of known facilities are indicated in Figure V-J.

Additionally, there are other kinds of cooperative educational undertakings involving telecommunications which affect a number of Texas schools. For example, in Austin, the educational VHF television station KLRN, in cooperation with the Capital Cable Company, is providing educational programs, via a different channel with citywide distribution, to almost all of the high schools in the Austin Independent School District, and plans are now underway to provide similar arrangements to the junior high level. It was not possible to determine the full scope of such scattered individual activities statewide within the temporal and financial constraints of this study, and their very discreteness makes them less appropriate for consideration than some other telecommunications activities in a statewide corrdinative effort.

Commercial. On the other hand, commercial CATV facilities are widespread. In Figure V-K, cities and towns with commercial CATV facilities are indicated; there are 289 such facilities in the state.

Most of the facilities are interconnected by microwave linkage systems, but several towns in close proximity to one another are connected by cable. Unfortunately, the locations served by CATV are not all in one system, and the several systems are not interconnected.

FM STATIONS IN TEXAS


KWTS
KTXT
KLSD
KGCC
KNTU
KTCU
KTEP
KOCV
KWBU
KNCT
KUT
KMFA
KTRU
KPFT
KUHF
KSYM
KTAI

KGCC	Denison
KLSD	Lubbock
KMFA	Austin
KNCT	Killeen
KNTU	Denton
KOCV	Odessa
KPFT	Houston
KSYM	San Antonio
KTAI	Kingsville
KTCU	Fort Worth
KTEP	El Paso
KTRU	Houston
KTXT	Lubbock
KUHF	Houston
KUT	Austin
KWBU	Waco
KWTS	Canyon

Figure V-H

SELECTED LOCAL CABLE/CLOSED CIRCUIT OPERATIONS IN TEXAS

Type of System	Location	Types of Material Broadcast	Sources of Programming	Grade Level of Audience	ADA	Annual Operating Budget and Source	Cost/ Student/ Year
2500 MHz closed circuit broadcast installation; 4 channels	Spring Branch ISD P. O. Box 19432 Houston, TX 77024 (713) 464-1511 Director, Dept. of Televised Instruction: Henry L. Thomas	Instructional programming	60% local; 40% purchased or leased from major producers	K-12 (on an equal basis)	36,185	$114,000, local and state funds	$3.16
2500 MHz closed circuit installation	Richardson ISD 8221 Towns St. Dallas, TX 75231 (214) 235-7770 TV Coordinator: H. H. Bobele	Enrichment of supplementary materials in all subject areas	Great Plains; NIT; Western Video; local production; various film distributors	K-12	34,500	$240,000	$6.96
ITV internal coaxial cable system	Denison ISD 800 S. Mirick Avenue Denison, TX 75020 Director of Special Services: W. L. Blankenship	Enrichment materials	Local production; TP&L films; special programs taped from commercial networks	K-12 (emphasis on elementary grades)	5,020	$7,000, plus the salaries of two teachers (est. @ $9,000 ea/yr), state and local funds	$4.98
ITV internal coaxial cable system; 1 channel	Waco ISD P. O. Drawer 27 Waco, TX Director, Instructional Media: Joe B. Gough	Educational materials, video tape and 16 mm film, primarily designed to supplement TV capability of two Waco high schools	Local production; commercial films	K-12	15,510 over 200*	$9,500, local funds	$6.13
ITV internal coaxial cable system (color); 6 channels	Highland Park High School 4220 Emerson Dallas, TX Audio Visual Director: Mike Robertson	Educational materials, primarily enrichment	Recorded programs from NBC, ABC, CBS, and PBS; some local production	9-12	1,611 200 to 500*	$11,323, local and state funds	$7.03
Closed circuit network to 33 viewing stations (elementary and secondary); community antenna (cable) network to 450 viewing stations (elementary); 2 channels	Laredo ISD 1702 Houston Laredo, TX 78040 (512) 722-5149 Director, Instructional Media Services/Instructional Television: Margie Weatherford	Instructional materials in oral language, writing readiness, art education, and English language arts at the primary level, and in English language arts, social studies, Spanish, Spanish cultural heritage, and science at the intermediate level	Local production; some programming from other sources (e.g., "Carrascolendas")	K-6	18,547 4,817-11,754*	$36,000, local funds; $104,584, Cultural Academic Enrichment Program (Title I, ESEA)	$7.58
Closed circuit installation; 2 channels	Texas School for the Deaf 1102 S. Congress Austin, TX 78704 (512) 442-7821 Acting Media Director: Carol J. Cunningham	General educational materials, including student news, a career quiz, and an interview program	Local production	N/A	525 150-250*	$100,000, Title I, ESEA	$190.48
Closed circuit installation; cooperative effort with local cable television company; 2 channels	Alice ISD 200 N. Reynolds Alice, TX 78332 Studio Manager, AISD-TV: Dottie Keetch	Instructional materials in bilingual education and career education; secondary student activities	Local production	K-12	5,713	$16,550, local funds; $25,000, ESEA	$7.27

*These figures indicate viewing audience per program or per day. However, cost per student per year is calculated on the basis of the ADA in all cases.

Figure V-I

CABLE AND CLOSED CIRCUIT EDUCATIONAL TV SYSTEMS IN TEXAS

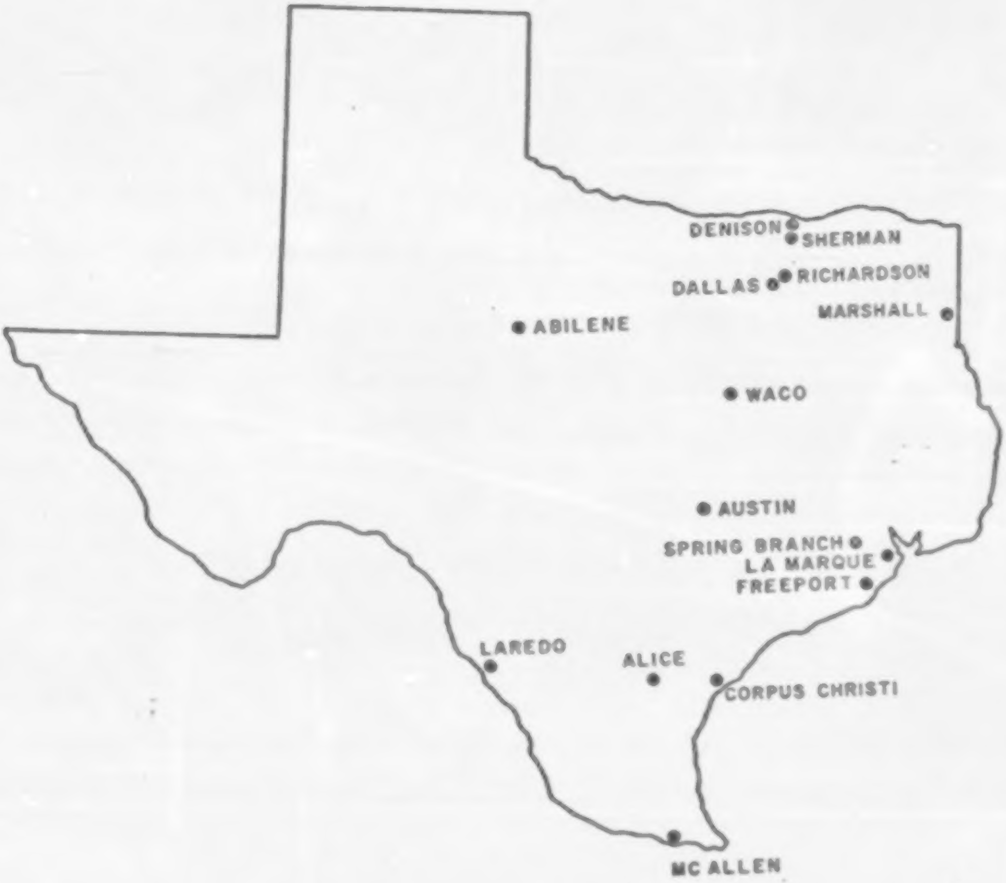

DENISON
SHERMAN
DALLAS
RICHARDSON
MARSHALL
ABILENE
WACO
AUSTIN
SPRING BRANCH
LA MARQUE
FREEPORT
LAREDO
ALICE
CORPUS CHRISTI
MC ALLEN

Figure V-J

COMMERCIAL CATV IN TEXAS

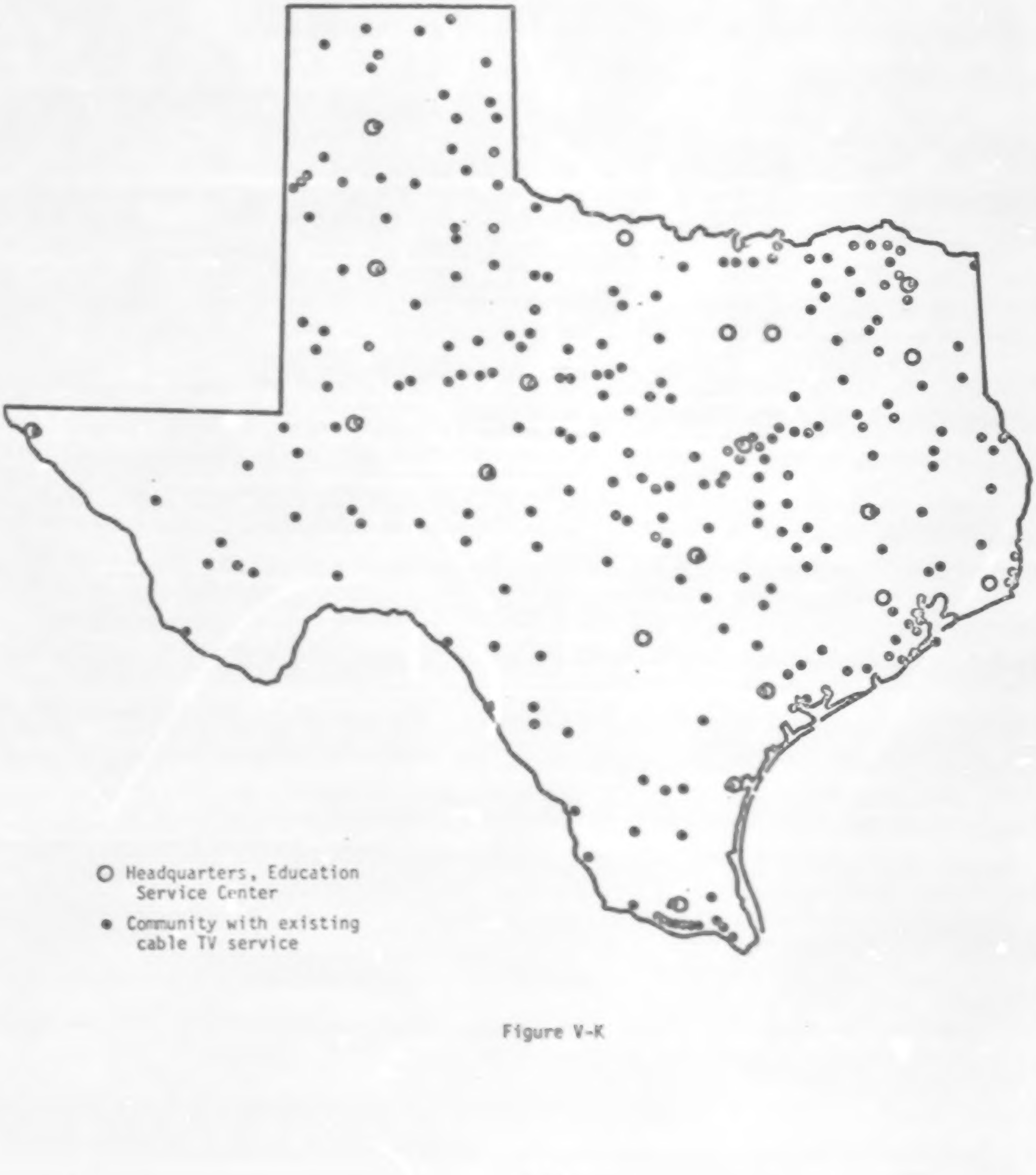

○ Headquarters, Education Service Center
● Community with existing cable TV service

Figure V-K

Also, it should be noted that several of the largest cities do not have CATV; there, a large number of broadcast stations are within normal reception areas, and household equipment can obtain satisfactory signals from all the stations, so that Houston, Dallas, Fort Worth, and San Antonio do not have CATV.

Nevertheless, the educational possibilities are great. It would be relatively inexpensive to extend CATV to still more Texas cities and towns (and hence to schools), and one or more educational channels could be programmed. Further, interconnections could be made between several of the networks, and the costs of programming lowered. This matter is discussed later in the report.

Library Networks

The importance of intra- and interstate library information storage and retrieval networks as a telecommunications resource should not be underestimated. In 1971 the Texas Library Association published a directory of all information-handling library networks within the state. These included both state and private educational libraries, industrial libraries, state agency libraries, and federal defense research libraries; the complete listing is shown in Appendix Charlie. Of all these networks, the most active is the Texas Information Exchange. Two of the networks, TAGER and TEMP, are not technically library networks and have been described earlier under Instructional Television Fixed Service (2500 MHz); the Education Service Center (ESC) network will be dealt with in a later section on instructional media resources, although the service centers do exchange books and other printed matter. Abbreviations for the various storage and retrieval networks are shown below.

CORAL	Council of Research and Academic Libraries
ESC	Education Service Center
IIS	Industrial Information Services
IUC	Interuniversity Council of the North Texas Area
NETINA	Northeast Texas Information Network Association
R.I.C.E.	Regional Information and Communication Exchange
SETINA	Southeast Texas Information Network Association
TAGER	The Association for Graduate Education and Research
TALON	TALON Regional Medical Library Program
TEKNET	Texas Education Knowledge Network
TEMP	Texas Educational Media Program
TIE	Texas Information Exchange
TSLCN	Texas State Library Communication Network
WIN	Western Information Network

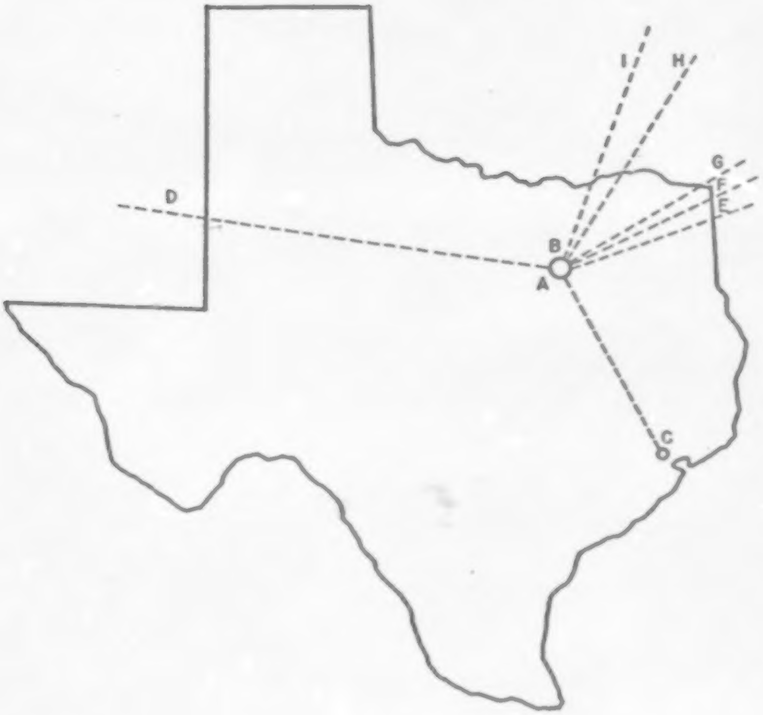
The networks not covered elsewhere in this document are depicted graphically on the following pages, in Figures V-L through V-Q.

Industrial Information Services. Industrial Information Services, headquartered at Southern Methodist University in Dallas, was set up to provide published information to business and industrial firms for use in their work. Sixty North Texas firms participate in this network, which is supported by membership dues and a fee structure. Resources used are those found in university and college libraries, private scientific and technical libraries, public libraries, and government information centers; these resources are transmitted to member organizations via mail, telephone, private line teletype, and TWX. IIS now interfaces with the Interuniversity Council of the North Texas area and the Regional Information and Communication Exchange. Future plans are to make the network self-sustaining, with clients bearing the full cost of services; to find ways to reduce fees; to increase access to more library collections; and to broaden the range of services offered. (See Figure V-L.)

Texas State Library Communication Network. The Texas State Library Communication Network, established and funded in 1968 under Title III of the federal Library Services and Construction Act, is designed to provide rapid delivery of documents and information to the citizen's

INDUSTRIAL INFORMATION SERVICES

(IIS)



HEADQUARTERS, SOUTHERN METHODIST UNIVERSITY SCIENCE LIBRARY, DALLAS

A. Telephone to private scientific and technical libraries in the Dallas and Fort Worth metropolitan areas.
B. Teletype to I.U.C. University Libraries on I.U.C. Network.
C. Telewrite exchange to Rice University, Houston, Texas.
D. Telewrite exchange to NASA Technology Application Center, Albuquerque, New Mexico.
E. Telephone to National Technical Information Services, Washington, D. C.
F. Telewrite exchange to American Institution of Aeronautics and Astronautics, New York.
G. Telephone to Institute of Scientific Information, Philadelphia.
H. Telewrite exchange to John Crearar Library, Chicago.
I. Telewrite exchange to Linda Hall Library, Kansas City.

Figure V-L

local community through an interlibrary loan network which utilizes the resources of major library collections of all types in Texas and the United States. The network, headquartered in the Texas State Library in Austin, serves all system-member public libraries in Texas. Each public library serves the information needs of all its citizens, who include college, community college, and school personnel, and patrons of various other types of libraries. Under the Statewide Plan for Library Development, Texas is divided into ten areas, with the largest library in each serving as the Major Resource Center. Other libraries serving more than 25,000 persons and meeting certain other criteria are designated area libraries. Requests from the smaller, or community, libraries may be filled through the area libraries or relayed to the Major Resource Center libraries and, ultimately, to the Texas State Library, which fills some of the requests and refers others to libraries both in and outside the state of Texas.

Since the TSLCN has merged with the Texas Information Exchange (TIE), the ten Major Resource Center libraries, the Texas State Library, and a number of the large academic libraries are able to communicate by teletype (TWX); area and community libraries may telephone requests to the larger libraries to which they are assigned. The Texas Numeric Register, begun in 1973 and published quarterly, aids in the identification and location of resources through provision of a list of Library of Congress Catalog Card and International Standard Book numbers for items cataloged in some thirty of the participating libraries. An interlibrary loan librarian at Major Resource Center level or above can thus determine the number of a requested item through a standard verification tool and then check the TNR to see which libraries in the network have the material.

Drawing in this manner upon the collections of member libraries as well as upon selected academic collections, TSLCN provides its members with interlibrary loan service, reference assistance, photoduplication, tape loan, microfilm loan, and union lists of books and journals. Future plans call for an extension of services. (See Figure V-M.)

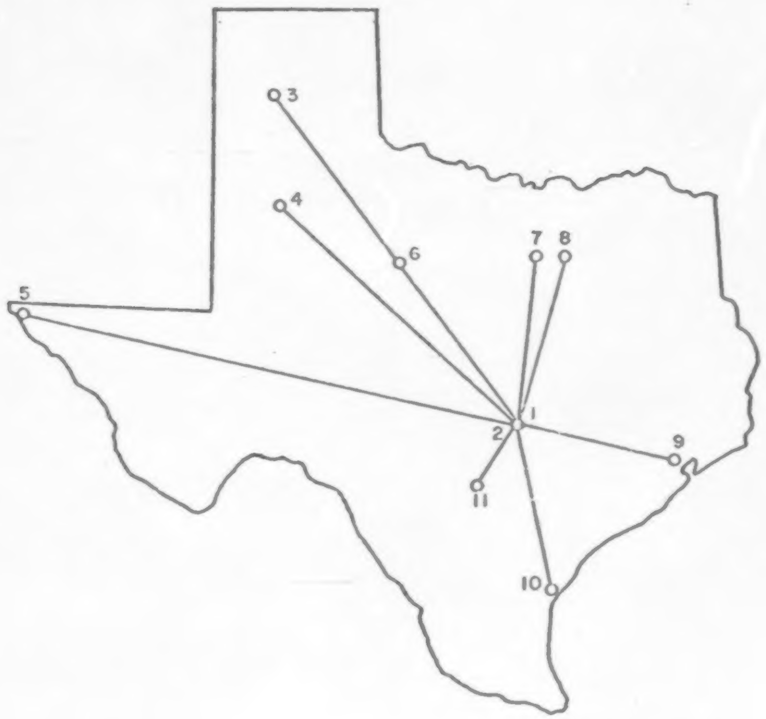
Texas Information Exchange. The Texas Information Exchange has its headquarters at the Fondren Library, Rice University, Houston. Established to strengthen and facilitate cooperation among Texas colleges and universities, TIE has as members 29 college and university libraries throughout the state, the ten Major Resource Center public libraries, the Texas State Library, and the Texas members of TALON. TIE is supported by membership fees, and utilizes the libraries of member institutions to provide interlibrary loan service, reference assistance, photoduplication, and microfilm loan. Requests may be made via TWX, and the system interfaces with IUC and TSLCN. In the future, this network proposes to develop a more formal organizational structure. (See Figure V-N.)

Northeast Texas Information Network Association. The Northest Texas Information Network Association, established in 1970 under H.B. 692, is comprised of 17 junior and senior colleges and universities in 50 counties in northeast Texas. Headquarters are at the University of Texas at Arlington. The purpose of this network is to promote the educational programs of the member institutions by authorizing the establishment and operation of a system for communications and information transfer between these institutions, and between the institutions and private educational institutions, industry, and the public. When operational, the NETINA system will utilize two-way closed circuit television and other electronic telecommunication techniques; operation and funding have yet to be determined. (See Figure V-O.)

Southeast Texas Information Network Association. The Southeast Texas Information Network Association, also set up under H.B. 692, is headquartered at KUHT-TV in Houston, and includes 15 public junior and senior colleges and universities from 31 counties in southeast Texas, with plans to add private institutions later. Its objectives and proposed method of operation are the same as those of NETINA; again, operations and funding have not been determined. Future plans are for the system to interconnect with NETINA, TEKNET, and WIN to form a comprehensive, statewide educational television network. (See Figure V-O.)

TEXAS STATE LIBRARY COMMUNICATION NETWORK

(TSLCN)

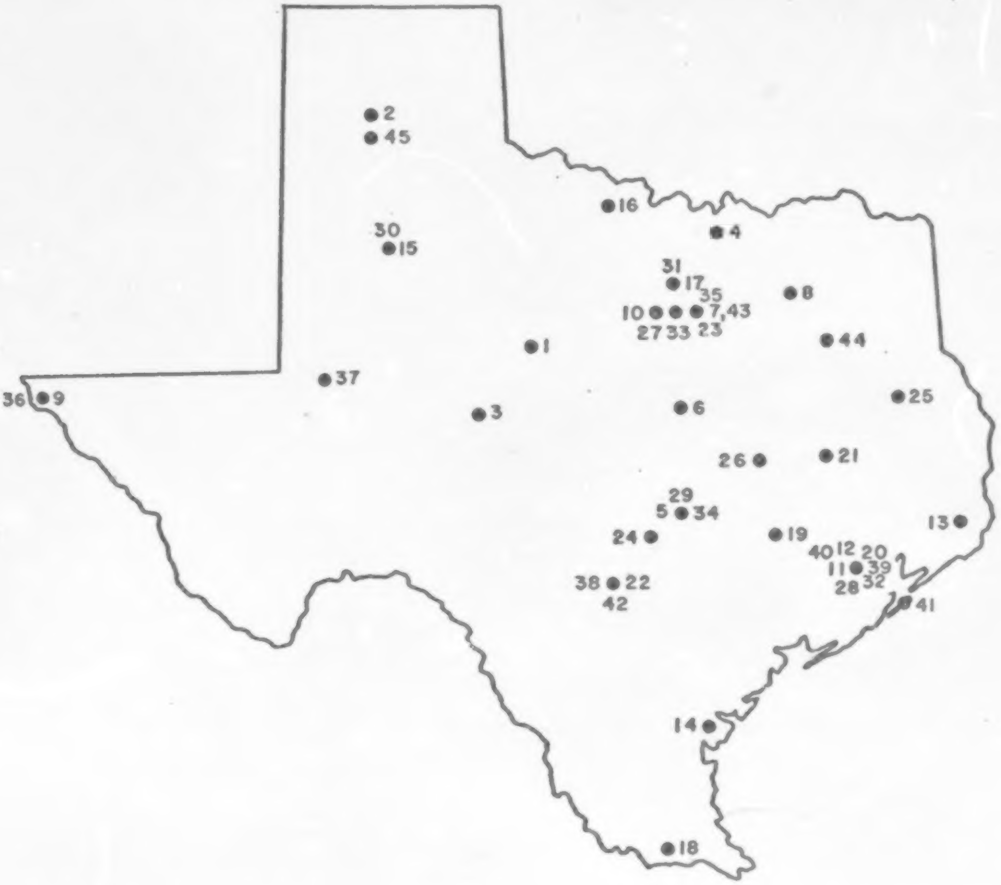


1. Texas State Library
2. Austin Public Library
3. Amarillo Public Library
4. Lubbock City-County Library
5. El Paso Public Library
6. Abilene Public Library
7. Fort Worth Public Library
8. Dallas Public Library
9. Houston Public Library
10. Corpus Christi Public Library
11. San Antonio Public Library

(There is direct switching between nodes.)

Figure V-M

TEXAS INFORMATION EXCHANGE
(TIE)



1. Abilene Public Library - Abilene
2. Amarillo Public Library - Amarillo
3. Angelo State University - San Angelo
4. Austin College - Sherman
5. Austin Public Library - Austin
6. Baylor University - Waco
7. Dallas Public Library - Dallas
8. East Texas State University - Commerce
9. El Paso Public Library - El Paso
10. Fort Worth Public Library - Fort Worth
11. Houston Academy of Medicine - Houston
12. Houston Public Library - Houston
13. Lamar University - Beaumont
14. La Retama Public Library - Corpus Christi
15. Lubbock City-County Library - Lubbock
16. Midwestern University - Wichita Falls
17. North Texas State University - Denton
18. Pan American University - Edinburg
19. Prairie View A&M University - Prairie View
20. Rice University - Houston
21. Sam Houston State University - Huntsville
22. San Antonio Public Library - San Antonio
23. Southern Methodist University - Dallas
24. Southwest Texas State University - San Marcos
25. Stephen F. Austin State University - Nacogdoches
26. Texas A&M University - College Station
27. Texas Christian University - Fort Worth
28. Texas Southern University - Houston
29. Texas State Library - Austin
30. Texas Tech University - Lubbock
31. Texas Woman's University - Denton
32. University of Houston - Houston
33. University of Texas at Arlington - Arlington
34. University of Texas at Austin - Austin
35. University of Texas at Dallas - Dallas
36. University of Texas at El Paso - El Paso
37. University of Texas at the Permian Basin - Odessa
38. University of Texas at San Antonio - San Antonio
39. University of Texas Dental Branch - Houston
40. University of Texas M.D. Anderson Hospital - Houston
41. University of Texas Medical Branch - Galveston
42. University of Texas Medical School - San Antonio
43. University of Texas Southwestern Medical School - Dallas
44. Tyler State College - Tyler
45. West Texas State University - Canyon

(There is direct switching between nodes.)

Figure V-N

TEXAS SECTIONAL INFORMATION NETWORKS

COLLEGE AND UNIVERSITY

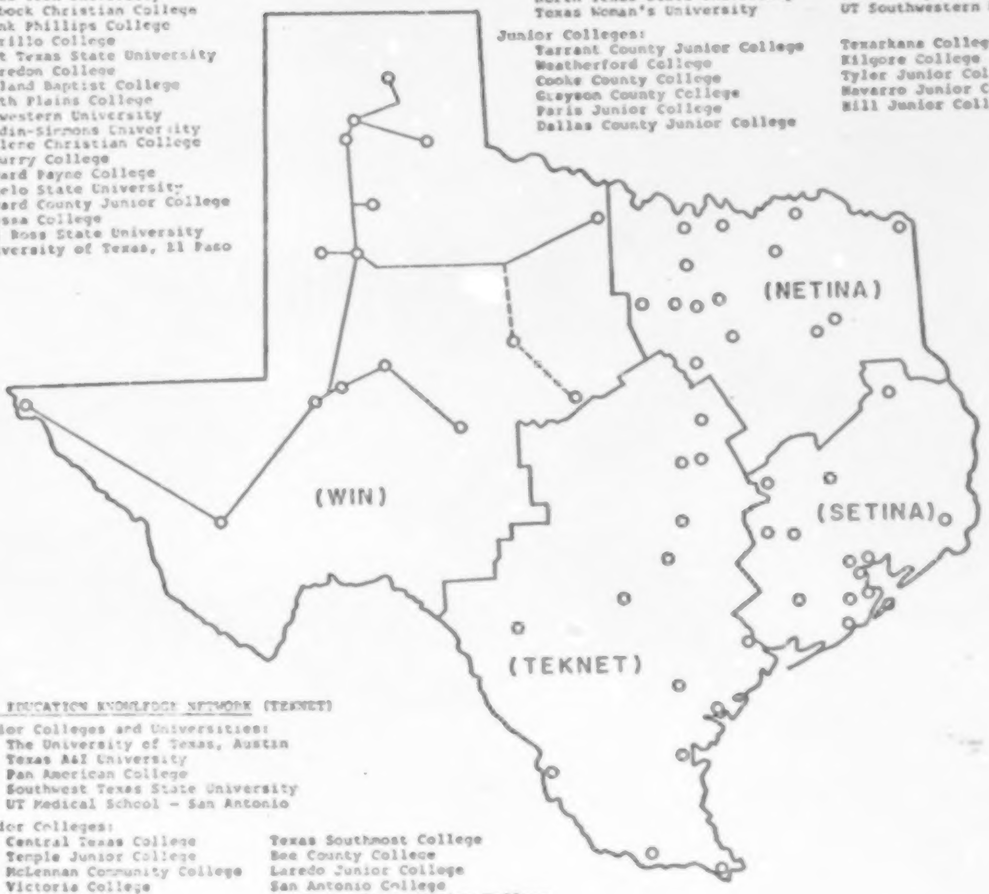
WESTERN INFORMATION NETWORK (WIN)

Texas Tech University
Lubbock Christian College
Frank Phillips College
Amarillo College
West Texas State University
Clarendon College
Wayland Baptist College
South Plains College
Midwestern University
Hardin-Simmons University
Abilene Christian College
McMurry College
Howard Payne College
Angelo State University
Howard County Junior College
Odessa College
Sul Ross State University
University of Texas, El Paso

NORTHEAST TEXAS INFORMATION NETWORK ASSOCIATION (NETINA)

Senior Colleges and Universities:
University of Texas, Arlington
North Texas State University
Texas Woman's University
East Texas State University
University of Texas, Dallas
UT Southwestern Medical School

Junior Colleges:
Tarrant County Junior College
Weatherford College
Cooke County College
Grayson County College
Paris Junior College
Dallas County Junior College
Texarkana College
Kilgore College
Tyler Junior College
Navarro Junior College
Hill Junior College



TEXAS EDUCATION KNOWLEDGE NETWORK (TEKNET)

Senior Colleges and Universities:
The University of Texas, Austin
Texas A&I University
Pan American College
Southwest Texas State University
UT Medical School – San Antonio

Junior Colleges:
Central Texas College
Temple Junior College
McLennan Community College
Victoria College
Del Mar College
Texas Southmost College
Bee County College
Laredo Junior College
San Antonio College
Southwest Texas Junior College

SOUTHEAST TEXAS INFORMATION NETWORK ASSOCIATION (SETINA)

Senior Colleges and Universities:
University of Houston
Texas Southern University
Texas A&M University
Sam Houston State University
Stephen F. Austin State University
Lamar State College of Technology
Prairie View A&M college

Junior Colleges:
San Jacinto College
Lee College
College of the Mainland
Galveston Community College
Alvin Junior College
Wharton County Junior College
Blinn College
Brazosport Junior College

Figure V-0

Texas Education Knowledge Network. The Texas Education Knowledge Network, like NETINA and SETINA, is designed to promote communications and transfer of information between institutions of higher learning, in this case five senior colleges and universities and ten junior colleges in a 67-county region of South Texas. Intended to interconnect with NETINA, SETINA, and WIN, TEKNET is not formally organized at this time. (See Figure V-O.)

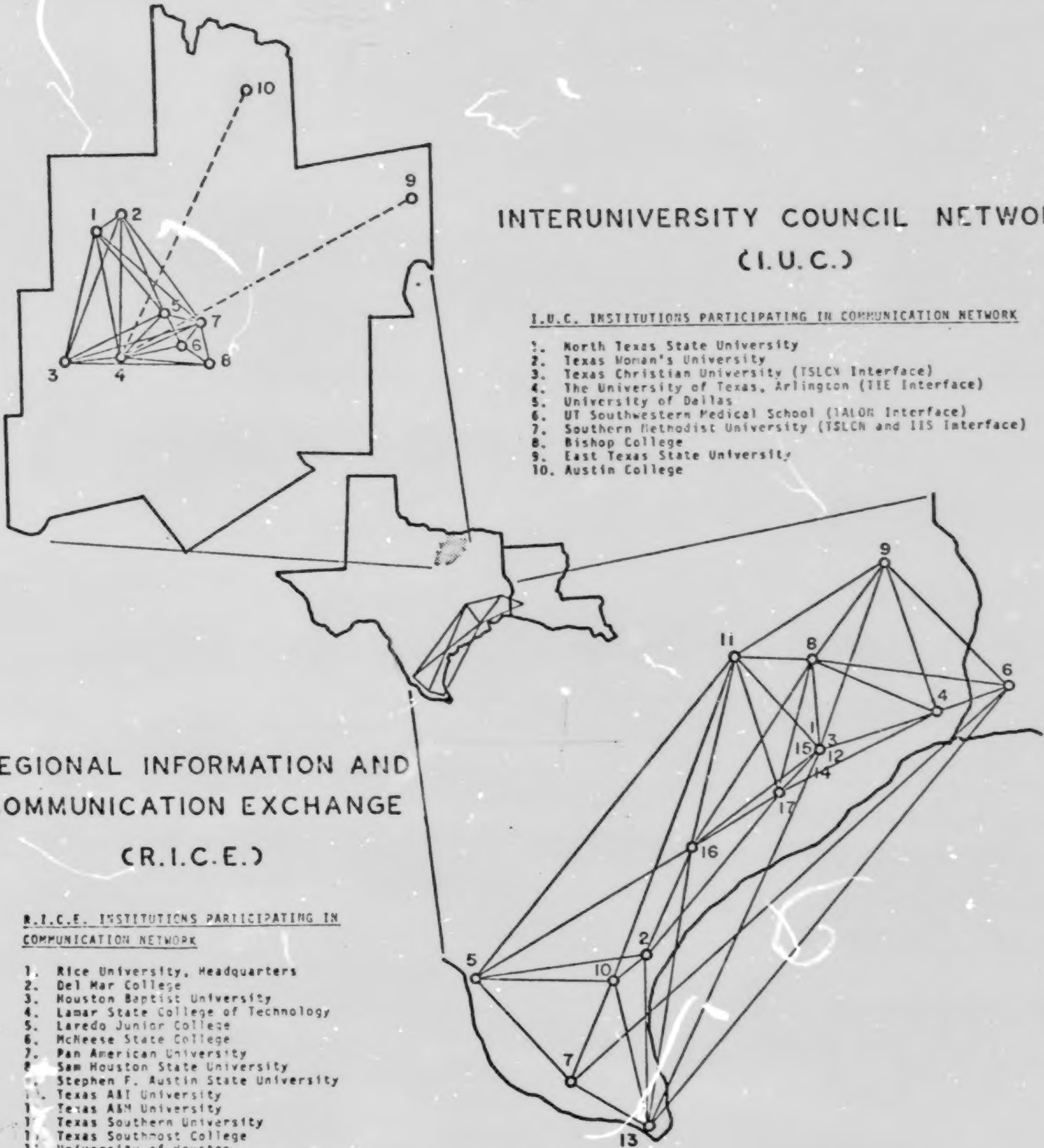
Western Information Network Association. The Western Information Network has as members 18 junior and senior colleges from 106 counties in West Texas. Headquarters are in Lubbock. Like NETINA, SETINA, and TEKNET, WIN was set up under H.B. 692 to provide member institutions with an information exchange and resource sharing service, via closed circuit television, computer modems, voice circuits, teletype circuits, and facsimile circuits. Ultimately, the system expects to interface with the other three state networks. (See Figure V-O.)

Interuniversity Council of the North Texas Area. The Interuniversity Council of the North Texas Area is a teletype network originally involving the academic libraries of ten senior colleges and universities in northeast Texas. The system, supported by a participant fee structure, is headquartered in Arlington. Its purposes are to promote interinstitutional cooperation among members, and, specifically, to provide service in the areas of location of library resources, arrangement of interlibrary loans, and exchange of photocopies. Other services available include cooperative acquisitions and provision of a union list of newspapers maintained by Major Resource Centers in Forth Worth and Dallas; future plans include expansion of loan privileges, improvement of cooperative acquisition, centralized processing, and joint sharing of staff resources. The IUC presently interfaces with TIE, TALON, IIS, and the Texas State Library Communications Network.

The IUC also maintains a linkage with the Ohio College Library Center in Columbus, a large computer-based system involving 435 schools throughout the country and having the capability to access more than 1,300,000 bibliographic citations. Within this year, the IUC as it presently exists is to be incorporated into the AMIGOS Bibliographic Council, which will also include academic and public libraries and one school library (the Irving ISD in Irving, Texas) in Texas, New Mexico, Oklahoma, Arizona, and Arkansas. All participating institutions will be connected to the Columbus computer base via dedicated telephone trunk lines, and thus will be able to call up citations or input new data, as well as use the system for interlibrary loans. The IUC will continue to function as the governing body when the AMIGOS program is operational. (See Figure V-P.)

Regional Information and Communication Exchange. The Regional Information and Communication Exchange is headquartered at the Fondren Library, Rice University, Houston, and includes 15 academic institutions and a number of business organizations in southeast Texas, as well as one college (McNeese State College) in Lake Charles, Louisiana. R.I.C.E., funded by a fee structure determined by the type of service desired, was set up to promote information interchange among the academic and industrial libraries of the region, and to function as a complete scientific and technical information center for business and industry. Services provided are interlibrary loans, reference assistance, literature searches, photoduplication, microfilm loans, patent copies, union lists of books and journals, translations, comprehensive bibliographies, verification, current awareness (SDI), and seminars. R.I.C.E. transmits materials and information by mail, telephone, and TWX; it interfaces with IIS and TIE. Future plans include the compilation of a regional union catalog. (See Figure V-P.)

TALON Regional Medical Library Program. The TALON Regional Medical Library Program, funded by a Regional Medical Grant for the federal government, has its headquarters at the University of Texas (Southwestern) Medical School in Dallas. The system is comprised of all medical school libraries in Texas, Arkansas, Louisiana, Oklahoma, and New Mexico, from the names of which states the acronym TALON is derived. Its objectives are: to provide rapid accessibility to medical information for all health-related professionals within the region; to develop a regional library and bibliographic network compatible with other Regional Medical Libraries in the nation; and to coordinate acquisitions of library materials in the region. Services to members include interlibrary loans, tape loans, film loans, microfilm loans, cooperative acquisitions, and union lists of books and journals; they are provided via



INTERUNIVERSITY COUNCIL NETWORK
(I.U.C.)

I.U.C. INSTITUTIONS PARTICIPATING IN COMMUNICATION NETWORK

1. North Texas State University
2. Texas Woman's University
3. Texas Christian University (TSLCN Interface)
4. The University of Texas, Arlington (TIE Interface)
5. University of Dallas
6. UT Southwestern Medical School (TALON Interface)
7. Southern Methodist University (TSLCN and IIS Interface)
8. Bishop College
9. East Texas State University
10. Austin College

REGIONAL INFORMATION AND COMMUNICATION EXCHANGE
(R.I.C.E.)

R.I.C.E. INSTITUTIONS PARTICIPATING IN COMMUNICATION NETWORK

1. Rice University, Headquarters
2. Del Mar College
3. Houston Baptist University
4. Lamar State College of Technology
5. Laredo Junior College
6. McNeese State College
7. Pan American University
8. Sam Houston State University
9. Stephen F. Austin State University
10. Texas A&I University
11. Texas A&M University
12. Texas Southern University
13. Texas Southmost College
14. University of Houston
15. University of St. Thomas
16. Victoria College
17. Wharton County Junior College

Figure V-P

teletype, an interface with TIE, and the National Union Catalog. TALON plans eventually to introduce computerization of statistical reporting and union lists of periodicals and monographs; microfilming of the union catalog of monographs; cooperative processing for small hospital libraries; experimental placement of other modes of communication; and workshops for network operator and user training. (See Figure V-Q.)

TEX-AN

The Texas Agency Network (TEX-AN) was established as a result of a telephone industry study which was initiated in 1969 and which indicated that the costs of communications within state government were rising excessively. The study determined that the area offering the greatest potential for slowing down these rapid cost increases was that of long distance or intrastate/intercity calling. Initially, the new TEX-AN system was to:

(1) Be restricted to state agency and intrastate calls;

(2) Serve the principal cities of the state within the network, while allowing for off-network provision at other locations;

(3) Use a parallel, uniform number calling code for ease of location and access;

(4) Have its own management, traffic, and pro-rata billing service to users;

(5) Consist of four major switching centers, to allow for efficient inter-trunking and tandem signalling; and

(6) Be capable of growth to handle increased voice use, as well as data and wide-band communications.

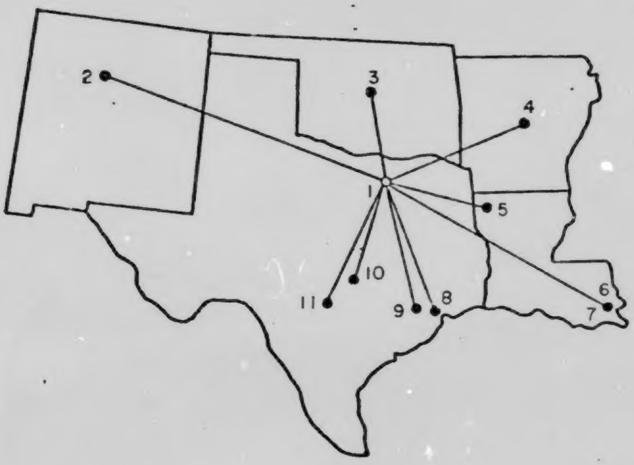
Generally, TEX-AN replaces intrastate long distance, private line voice, and Wide Area Telephone Service (WATS), but not local voice arrangements which remain individual agency responsibilities. In essence, its coverage is a smaller, instate version of the Bell Telephone switched network.

The original plan for the TEX-AN trunking scheme is shown in Figure V-R. All TEX-AN circuits terminate in one of the four switcher locations (Abilene, Austin, Dallas, and Houston), providing both on-net and off-net accessibility. At present there are 51 locations throughout the state which provide this off-net service. Off-to-on network calls may incur a toll charge, in addition to the TEX-AN charges, for a call from the originating location to the nearest TEX-AN entry point.

The network became operational in March, 1974. Cost analysis on the basis of a year's operation indicates that TEX-AN has achieved its original objective of flattening the cost curve. Original estimates placed service charges at 16 cents per minute; the actual costs have varied between 12 and 14.8 cents per minute. In August, 1973, long distance costs to state government were an estimated 28 cents per minute. Projection trend analysis has shown that these costs, as a result of TEX-AN, were approximately $100,000 less a month as of April, 1975. Thus, the year's operational/cost data for the network have established that it is cost-effective and has produced operational capability not otherwise achievable except at a greatly increased cost.

With the phasing out of the Texas Education Agency's Office of Information Services, TEX-AN will be placed under the jurisdiction of the State Board of Control. Legislation is pending, and is expected to be approved, for establishing official status for the network. At this point, the system does not lease any video bandwidth services and is restricted to providing voice and data services.

TALON REGIONAL MEDICAL LIBRARY PROGRAM (TALON)



1. University of Texas (Southwestern) Medical School, Dallas
2. University of New Mexico School of Medicine, Albuquerque
3. University of Oklahoma Medical Center, Oklahoma City
4. University of Arkansas Medical Center, Little Rock
5. Louisiana State University School of Medicine, Shreveport
6. Tulane University School of Medicine, New Orleans
7. Louisiana State University Medical Center, New Orleans
8. University of Texas Medical Branch, Galveston
9. Houston Academy of Medicine Library, Houston
10. Texas Medical Association Library, Austin
11. University of Texas Medical School, San Antonio

Figure V-Q

TEX-AN TRUNKING

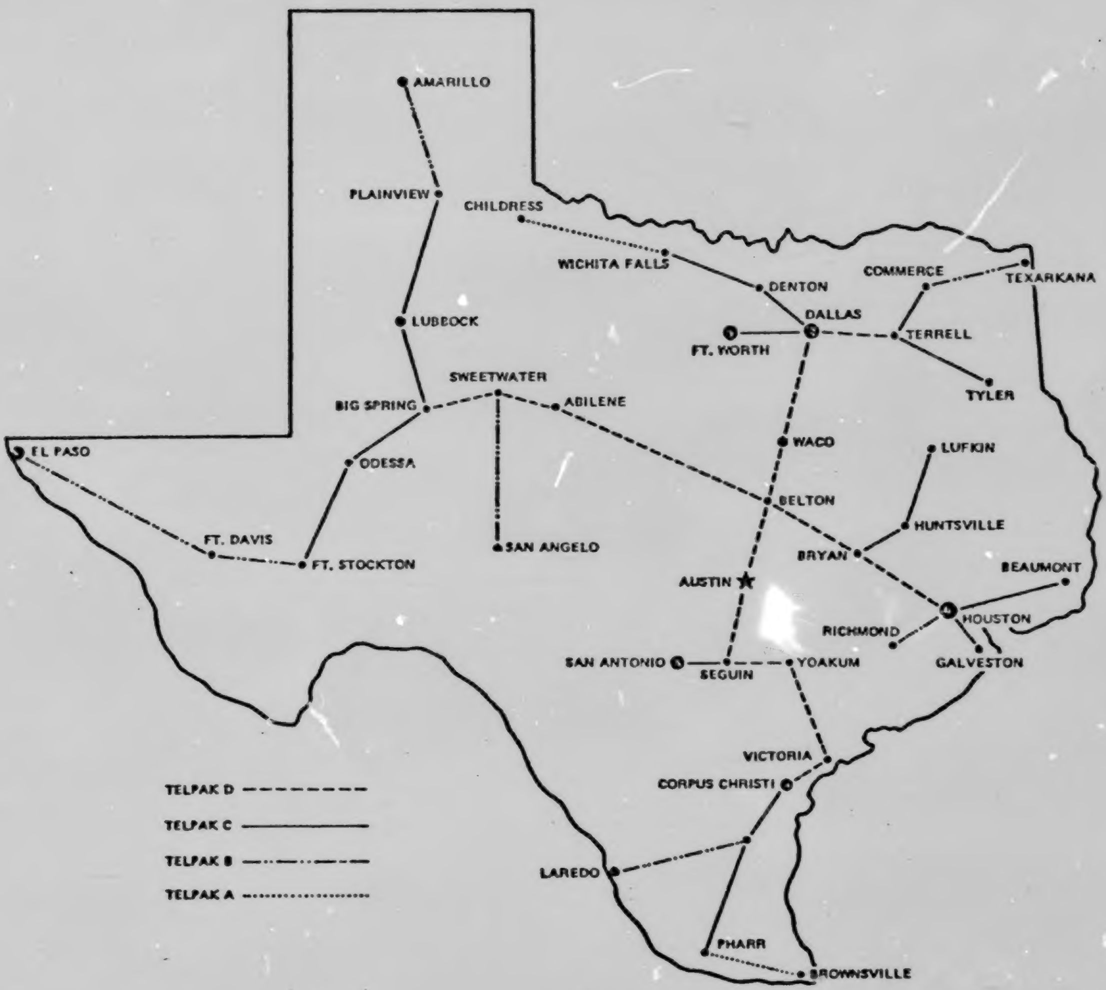

AMARILLO
PLAINVIEW
CHILDRESS
WICHITA FALLS
DENTON
COMMERCE
TEXARKANA
LUBBOCK
DALLAS
FT. WORTH
TERRELL
TYLER
SWEETWATER
BIG SPRING
ABILENE
EL PASO
ODESSA
WACO
LUFKIN
BELTON
HUNTSVILLE
FT. DAVIS
FT. STOCKTON
SAN ANGELO
BRYAN
BEAUMONT
AUSTIN
HOUSTON
RICHMOND
SAN ANTONIO
SEGUIN
YOAKUM
GALVESTON
VICTORIA
CORPUS CHRISTI
LAREDO
PHARR
BROWNSVILLE
TELPAK D
TELPAK C
TELPAK B
TELPAK A

Figure V-R

Texas Education Agency: Management Information Center

Within the Texas Education Agency, the Management Information Center (MIC) is, among various other duties, responsible for management information (data processing) activities as well as for centralized computer coordination and related functions for the twenty Regional Education Service Centers. This dual responsibility, including the function of data processing for the Texas Education Agency, plus programming and maintenance of computer data banks, file management, and computer activity coordination for those centers which have or use computers, is delineated in the State Plan for Computer Services in Texas, approved by the State Board of Education in 1971. Specific objectives stated in the State Plan are:

-To establish a statewide network for providing computer services to school districts;

-To implement administrative, educational, and information system usage of the computer;

-To encourage and assist school districts in the use of these services;

-To make computer services available in an economical and effective manner;

-To ensure provision of comparable basic services to all districts as far as it is practical. (Texas Education Agency, A Cooperative Approach to School Data Processing Services, 1975)

The Texas Education Agency itself has some in-house data processing capability, provided by a Univac Model 1050 processor with peripherals. Some of the TEA data processing is performed through two remote job entry terminals: the first terminal is connected via a private line, high speed (9600 BAUD) data circuit to the Richardson Education Service Center's IBM 370/145, which has five alternatives; the second terminal is connected via a similar high speed data arrangement to Texas A&M University's 370/145, which has two alternatives. Both services provide programming capability and data processing functions for the Management Information Center. As programs are developed, they are tested and standardized in terms of administrative support functions, and are coordinated with those Education Service Centers having a computer capability. With the approval of each center, the programs are installed on the various service center systems. Programs tested by and currently available through the Management Information Center system include (1) class scheduling, (2) grade reporting, (3) payroll, (4) financial accounting, (5) attendance accounting, (6) test scoring, (7) tax accounting, and (8) personnel accounting, although some of these are presently in limited use.

The Texas Education Agency, in an effort to obtain proven management software packages for file maintenance of all records, plans to obtain a "turnkey package" of programs called TOTAL. Though ideal in principle, the establishment of a central data base for all educational information would be somewhat difficult because of the following factors:

(1) Only the larger school districts (and ESC's) can afford the acquisition and operation of computer facilities; the very small school districts cannot pay for such facilities.

(2) Some of the smaller ESC's are satellited on the larger ESC computers via remote terminal linkage using telephone lines.

(3) Management support and instructional applications of software already proven effective are in various stages of development, and will be for some time.

However, a comprehensive plan entitled Master Plan for Electronic Data Processing (Texas Education Agency, 1974) is now being implemented; the Network-System Plan for Computer Services (Texas Education Agency, 1975), which is the fourth annual version of this latter type of plan, gives specific details on hardware, software, funding, and scheduling.

In summary, the MIC and the service centers presently provide a number of computer facilities, programming efforts, and remote facilities to satisfy a number of objectives. Further discussion of computer activities carried on by and through the Education Service Centers appears in the next section of this chapter, under the heading "Education Service Center Communications."

Education Service Center Communications

The twenty Regional Education Service Centers (ESC's) were made operational in 1967 after authorization by the 60th Legislature. Among other services, they were designed to serve as quasi-official state agencies for the acquisition, development, cataloging, evaluation, coordination, distribution, and control of media for use in school districts in their regions; together, they constitute a comprehensive network for the provision of media as needed. (See Figure V-S.)

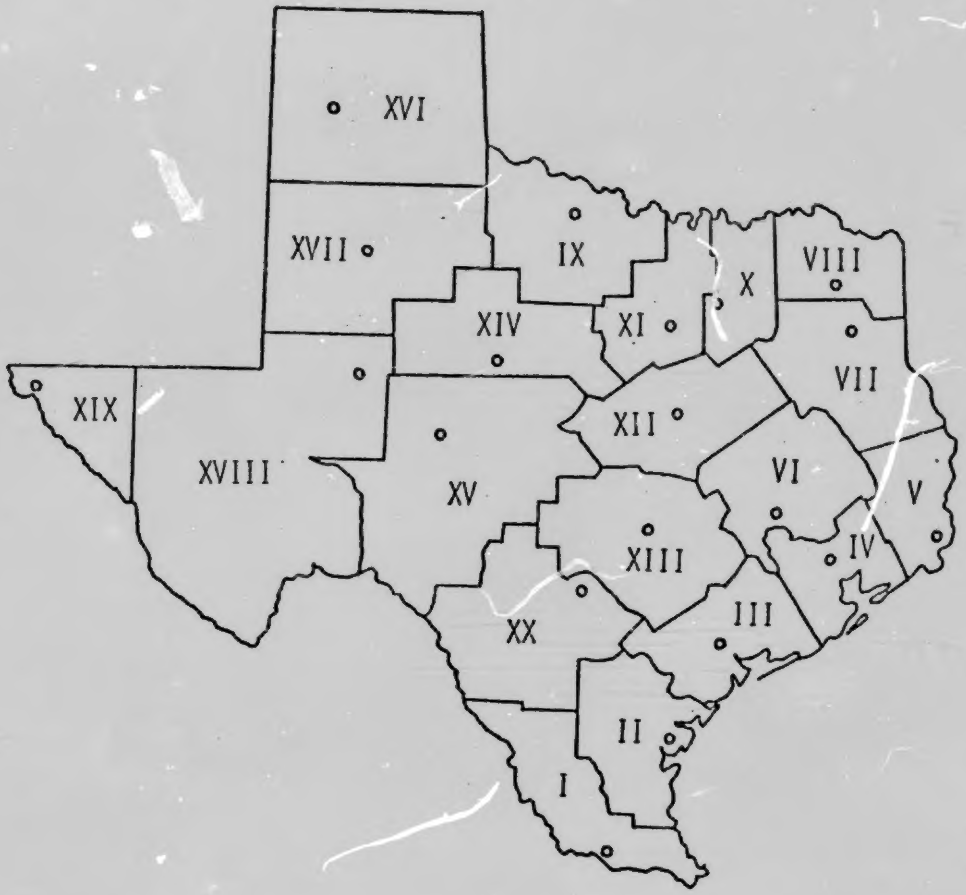
As indicated elsewhere in this chapter, the Texas Education Agency, with the approval of the State Board of Education, is implementing a State Plan for Computer Services. The content of this plan includes broad statewide objectives for establishing a computer network and computer services to be provided to school districts. Technical assistance and support have been provided to the service centers by the Agency, in addition to funding for the necessary facilities. The Network-System Plan for Computer Services delineates several types of data processing support centers:

Multi-Regional Processing Center. A Multi-Regional Processing Center is a large computer facility designated in this Plan as having responsibility for providing services to local school districts in two or more education service center regions. The central processing unit employed in the MRPC must have hardware and software capable of performing both in-house batch and remote batch processing in a multi-programming environment. The MRPC facilities must be flexible in order to meet the changing demands of the users they serve.

Regional Work Station. A Regional Work Station is a location where computer services inputs are collected and prepared for computer processing and where computer processing outputs are distributed to the users. The RWS will usually be located in an education service center administrative building. Each of the twenty education service center regions will have a RWS. In regions where the MRPC is located, the RWS will normally be located at the computer facility site. For other regions, there may or may not be a remote terminal located at the RWS, depending upon the method of delivery justified by the volume of computer processing services. Possible methods of providing computer services are:

> Regional Processing Center. A Regional Processing Center is a computer facility designated in this Plan as having responsibility for providing services to local school districts in one or two education service center regions. The computer facility utilized by the RPC may or may not be under full-time operational control of the education service center providing the service.
>
> Remote-Job-Entry. Remote-Job-Entry is a method of transmitting data and control instructions from a remote location to an education service center computer processing facility where the data is processed according to the instructions transmitted in the control language. The jobs are processed in the same relative priority and have access to the same central configuration as if they were input directly at the central site. The output is transmitted back to the remote terminal if requested by the control language. Remote terminals used to implement this method usually consist of a card reader-line printer combination, but can have other types of input-output units attached.
>
> Remote-Data-Entry. Remote-Data-Entry is a method of transmitting data from a remote terminal location to an MRPC. Processing of the data is not directly controlled by the remote location.

REGIONAL EDUCATION SERVICE CENTERS


XVI
XVII
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II
I

REGION	HEADQUARTERS	REGION	HEADQUARTERS
I	Edinburg	XI	Fort Worth
II	Corpus Christi	XII	Waco
III	Victoria	XIII	Austin
IV	Houston	XIV	Abilene
V	Beaumont	XV	San Angelo
VI	Huntsville	XVI	Amarillo
VII	Kilgore	XVII	Lubbock
VIII	Mount Pleasant	XVIII	Midland
IX	Wichita Falls	XIX	El Paso
X	Richardson	XX	San Antonio

Figure V-S

Transportation of Documents. Data Transportation is provided via auto, bus, mail air freight, contract courier, etc., from a regional work station to a central computing facility. (Texas Education Agency, 1975)

Of the twelve service centers which did not operate their own computer processing facilities during the year 1974-75, nine were equipped with remote job entry terminals linked to the nearest support center. Three of the centers utilize their computers on a multi-functional basis, including computer-assisted instruction. The data processing capabilities and CAI activities of the service centers are discussed more fully under the sections of this chapter entitled "Texas Education Agency: Management Information Center" and "Computer Networks," and presented in tabular form in Appendix Delta.

While each of the centers maintains its own integrity of operation, it would be impossible to separate the data processing function of the Agency from the field operations of the centers. Indeed, the advantages of standard, compatible, interchangeable operations and procedures are great and offer the greatest hope for more efficient, effective, and economical results. The impact of the service centers with regard to increasing the instructional materials available to adjacent schools and communities has been a significant one, and their potential role in any statewide coordination of such an effort should be equally significant.

Computer Networks

A survey of secondary schools in the United States (Darby, Karotkin, and Romashko, 1970) found that 34 percent of the nation's approximately 23,000 secondary schools have access to and use a computer for administrative and/or instructional purposes. At this point, no such survey has been conducted in Texas to determine the extent of computer use within individual schools, but information is available on its use either for administration or for instruction in eight of the twenty service center regions of the state. The data which undergo computer transmission and storage by the service centers constitute a part of the overall management information system of the Texas Education Agency, as well as providing support for computer-assisted instruction in Texas public schools. Only three of the service centers are now using computers specifically for instructional purposes: the Gulf Texas Multi-Regional Processing Center at Houston, the North Texas Multi-Regional Processing Center at Richardson, and the South Texas Multi-Regional Processing Center at San Antonio offer school districts instructional computer services through the use of interactive terminals. CAI applications include problem solving, simulation (games), and drill and practice. The Gulf Texas MRPC provides its services through a CDC-6600 computer, while the North Texas and South Texas MRPC's are using Hewlett Packard 2000F computers for instructional applications. A complete chart of Education Service Center data processing facilities is attached as Appendix Delta. With the increased use of computers in various instructional activities, other computer networks have been organized within the state, and are continuing to grow in size of operation.

One important higher education system operating within Texas is CONDUIT, which is part of a national network established and funded by the National Science Foundation in December 1971. CONDUIT (an acronym for a consortium formed by Dartmouth and the Universities of Oregon, Iowa, and Texas) actually involves eight universities serving as regional centers for the exchange of computerized instructional materials among themselves and among other participating institutions. Designed to promote the utilization of these extensively developed materials in places other than the originating location, CONDUIT represents over 100 institutions of higher learning and over 350,000 students.

During the first phase of its operation, CONDUIT defined problem areas in dissemination of instructional materials utilizing computers and conducted a dissemination experiment. Data were collected on the costs and problems of conversion and maintenance of these materials for differing computer environments, and on faculty and student response to their use. CONDUIT is presently reviewing the results of the experiment and testing solutions to the problems identified. Barriers to transfer and dissemination of materials have been grouped into technical, psychological, and institutional categories, and this phase will result in a published analysis of the problems and a set of guides designed to alleviate them. Subsequently, CONDUIT will design a model for a national organization to facilitate exchange of computer materials.

The Southern Regional Network (see Figure V-T), based at the University of Texas in Austin, represents the local CONDUIT site and includes both in-state colleges and high schools in the Austin vicinity. Its purpose is to allow users access to CAI courseware that is available on the University of Texas CDC-6600 interactive time-sharing system (TAURUS). Through this capability, remote users have access to a wide variety of software. Eventually, this network will be expanded through provision of Digital Equipment Corporation model PDP-KI-10, dedicated solely to instructional purposes, which can accommodate 64 terminals with the capability of expansion to 128 terminals.

LEGISLATIVE ASPECTS

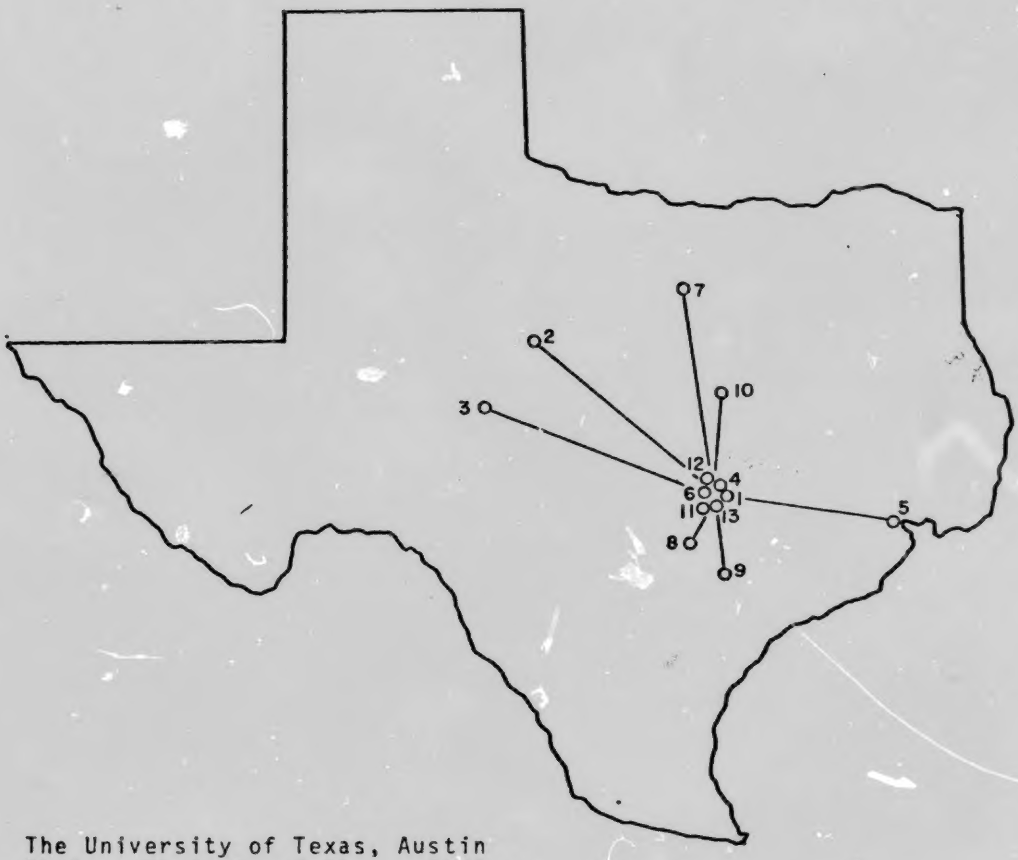
General Background

In the United States public education normally is controlled and regulated by individual states, through state boards of education which operate under laws enacted by and appropriations granted through state legislative authority. On a higher level, the federal government, under the authority vested in Congress, is empowered to impose and collect taxes, duties, imports, and excises in order to pay debts and provide for the common defense *and general welfare* of the U. S. (Denzan, 1971). The term *general welfare* has been interpreted by the Supreme Court as providing further authorization for Congress to expend tax monies directly related to this function, which includes broad responsibility for public education of the nation. Evidence of this interpretation can be found as early as in the Ordinances of 1785 and 1787, which provided land grants from the public domain to individual states for the maintenance of public schools, pursuant to the declaration that religion, morality, and knowledge were necessary to good government and the happiness of mankind, and that schools and the means of education should therefore be encouraged.

In later years, many acts with similar intent were passed by Congress, such as the 1917 Vocational Act, the 1946 National School Lunch Act, the 1958 National Defense Education Act, and the Elementary and Secondary Education Act of 1965 with its subsequent amendments. In fostering these acts, the federal government has had a major impact upon public education, although in all instances, regardless of the federal agencies involved (e.g., National Science Foundation; Office of Education, Department of Health, Education, and Welfare), once assistance has been given individual states in the form of monies, equipment, or services for education, administration of the programs has been conducted by the states involved, and under state legislative acts or laws. Selection and use of specific courses of instruction must be approved by the state legislature through its policy-making arm, the state board of education, and in turn through its operations arm, the state educational agency. Many states have statutes making mandatory the teaching in public schools of certain basic subjects, e.g., state constitution, civics, or government. Apparently, the only limitation as to the curriculum taught is that of the presentation of information which is specifically injurious to the health, morals, or understanding of the ordinary child [*Meyer v. Nebraska* 262 U.S. 390 (1923)].

Under the category of curricula are also included textbooks which must be approved. In most instances, the legislature passes this authority on to the state board of education. Supplementary materials such as audiovisual materials (films, filmstrips, audio tapes, slides, etc.) fall into the category of textbooks and can easily be examined for adoption. However, with the advent of electronic courseware such as computer programs, video tape programs, 3-D laser holograms, and a host of other new and sophisticated teaching materials that require more expensive and more complex equipment to display or operate the program, adoption procedures have become more difficult. For example, the curricular material contained in computer programs has not only the one dimension of professionally acceptable content, but also

SOUTHWEST REGION EDUCATIONAL COMPUTER NETWORK



1. The University of Texas, Austin
2. Abilene Christian College, Abilene
3. Angelo State University, San Angelo
4. Huston-Tillotson College, Austin
5. Rice University, Houston
6. St. Edward's University, Austin
7. Texas Christian University, Fort Worth
8. Southwest Texas State University, San Marcos
9. Texas Lutheran College, Seguin
10. Baylor University, Waco
11. St. Stephen's Episcopal School, Austin
12. Concordia College, Austin
13. Austin Independent School District High Schools

Figure V-T

instructional design parameters which may include the pedagogical elements of tutorial presentation, simulation techniques, and built-in testing and scoring sections. Thus the task of approval becomes more complex both for the legislature and for the state board of education, since the decision involves buying not just a film and a projector, but rather a complete program and a computer system or service as well.

The Texas legislature has been aware of the need for statutory control over educational television, and in 1971 enacted Senate Bill 149 (Public School Television Instructional Services), which provides budgetary support for ETV based upon the average daily attendance of each school. Unfortunately, no such act has been passed regarding computer-managed instruction, and this problem is still being studied by the Texas Education Agency on a long range basis. One very difficult question yet to be resolved is that of standard copyright for computer programs. While books or other proprietary or original published materials can be copyrighted, the problem with respect to computers is an altogether different one, because computer programs, although copyrighted, still may be incompatible with different systems, and there is also a lack of guidelines for creating and marketing programs. "Stealing" of computer programs from other systems is not new in the field of data processing, and the safeguards in use often do not stop unscrupulous individuals. As to the availability of computer-based curricula, a large number of such curricula exist, some copyrighted, but these are designed primarily for large, highly specialized systems such as the PLATO IV System of the University of Illinois and the MITRE Corporation TICCIT System. The life expectancy of computer courses to a great extent parallels that of books, which are revised or updated every three to four years, with new books written aften that period. Similarly, in relation to the advent of cheap copying machines, a computer can duplicate a program on a magnetic tape in a matter of minutes.

With respect to the use of telecommunications as a transmission path for the copying of computer programs or video tapes, the copyright or "prohibited use restriction" still applies to educational institutions wishing to use such materials, and funds are required not only for the cost of the magnetic tape but for royalties and labor costs as well. Normally material in the public domain (e.g., video program material funded by the federal government) incurs only a one-time charge for a master tape, but programs must be closely examined to eliminate the possibility of a lawsuit if the material is commercially produced. When computer programs are copied on tape or cards, "replaying" them in a system can produce either record (printed) or non-record (visual display) copy; in either case, if the cycle is completed the copyright provisions regarding ownership of the material go into effect.

To complicate the matter further, the Supreme Court has ruled that if a motion picture is projected upon a screen, it is not considered to have been copied. However, projecting the image of a computer program on a large television screen might possibly be interpreted as copying the program, and the question of video-projection copyright thus has yet to be decided by the courts. Furthermore, the matter of copyright infringement or liability for programs transmitted via a CATV system still has to be settled by the Federal Communications Commission and Congress. It is clear that, if teachers are to use new technologies and curricula involving electronically recorded media, then the extent of their unrestricted use in the classroom must be clearly defined for telecommunications systems. In this connection, educational broadcasters are presently permitted to make no more than twelve copies of any works transmitted. The copies cannot be further duplicated and all but one must be destroyed within five years after the date of the first transmission.

In summary, the use of copyrighted electronically recorded educational materials via educational telecommunications systems is seriously impeded by present copyright laws. The considerations covered in the body of this section all point either to a centralized program duplication facility or to regional facilities using common standards, with each facility scrupulously observing copyright regulations. (See also Chapter IV,"Software," on copyright.)

Proposed Legislation

The following is a summary of legislation relevant to the purposes of this study which was introduced during the last session of the Texas legislature.

Bill. House Bill 1445 introduced by McAlister on March 13, 1975. This bill concerns financial support for instructional television services for public school districts and amends Subsection (b), Section 21.911, of the Texas Education Code as renumbered by Section 18, Chapter 51, Acts of the 63rd Legislature, Regular Session, 1973.

Recommendation. That the annual cost of television service programs provided by a school district be borne two-thirds by the state and one-third by the district, rather than equally by both, provided that the state's share of the cost does not exceed $1.50 (formerly $.75) per pupil. Total costs will be determined on the basis of Average Daily Attendance (ADA) of the district for the preceding school year.

Status. This bill died in the House Committee on Public Education.

Bill. Senate Bill 607 introduced by McKinnon on March 10, 1975. This bill provides state financial support on a limited basis for instructional television services and equipment and amends and renumbers Section 21.911 of the Education Code, entitled "Financial Support for Instructional Television Services" and based on S. B. 149.

Recommendation. The initial recommendation is the same as that of House Bill 1445 above: that the costs of television service programs provided by a school district be borne two-thirds by the state and one-third by the district, with the provision that the state's share not exceed $1.50 per pupil based on the district's ADA for the preceding year. Additional recommendations are (1) that school districts providing educational television programs to enrich classroom instruction also be eligible to apply for state funds from the Foundation School Program for purchase and maintenance of television receivers, antennas, and wiring within the school buildings, with the provision that the total cost to the Foundation School Program not exceed one million dollars for the next biennium; and (2) that any educational public television station qualified by the Texas Education Agency as a "major production center" be eligible to apply for grants for production of instructional television series from the Instructional Television Production Fund to be established under the Foundation School Fund, with the provision that the amount appropriated for the former fund not exceed one million dollars for the next biennium.

Status. This bill went through Senate Education Committee 310 but was not heard before the session ended.

Bill. Senate Bill 710 introduced by Mauzy on March 13, 1975. This bill declares public policy regarding the non-commercial educational/public television stations of Texas; charges the Coordinating Board, Texas College and University Systems, with the development of educational/public television as appropriate; and defines its duties and powers for this purpose.

Recommendation. The Coordinating Board will make "Continuing Education Grants" to non-commercial television stations; these grants will be based equally upon (1) a formula developed by the Coordinating Board and (2) a total of non-state funded budgets for each station. A minimum grant of $50,000 and a maximum of $250,000 may be made annually to each station. The Coordinating Board will make matching "Development Grants" to agencies, institutions, or non-profit corporations to assist in the establishment of educational/public television stations in cities and regions of the state not now receiving such service. These grants will be based on Coordinating Board planning for statewide service; a maximum grant of $100,000 may be made to any single organization. The Board will cooperate with the four statutory Information Network Associations toward the eventual establishment and operation of a statewide educational/public television network.

Status. This bill passed the Senate and went through the House Committee on Higher Education, but was not heard before the session ended.

Bill. House Bill 1576 introduced by Delco on March 19, 1975. This bill seeks to provide financial assistance for computer information services through the Regional Education Service Centers and amends Subsections (d) and (f), Section 11.33, of the Texas Education Code as amended.

Recommendation. The Texas Education Agency will be responsible for development and implementation of computer systems to provide a common core of educational data on all school districts in order to meet regional and statewide needs in the areas of planning, evaluation, and accountability. The State Board of Education will budget annually from the Foundation School Program fund a predetermined allotment for computer services to be paid to eligible (under requirements determined in advance by the State Board) Regional Education Service Centers; this allotment will comprise .03% of the total cost of the Foundation School Program for fiscal years 1976 and 1977, .04% for FY 1978, and .05% for FY 1979 and each FY thereafter.

Status. This bill died in the House Committee on Public Education.

IMPLICATIONS

In summary, a large number of telecommunications networks are used either directly for or in conjunction with public education in the state of Texas. These include voice telephone (TEX-AN), radio broadcast, television broadcast, instructional fixed service television, community antenna television (coaxial cable), teletypewriter exchange (message handling), and computer-assisted instruction networks. While these networks are continuing to expand, both in size and in number, this expansion is taking place only in the larger cities, with no provision made for any type of telecommunications services to the small, remote schools with 50 or fewer students in grades K-8 or 100 or fewer in 9-12. This problem is a complex one, and it must be analyzed in terms of telecommunications or related services now in use in the smaller school facilities, with a view to adapting these services to the newer technologies. Such an adaptation might result, for example, in the use of independent video tape playback systems or standalone (intelligent) computer terminals by students on an individual basis. Basic assumptions which should be stated at this point are as follows:

(1) Every remote school, no matter how small, does have a telephone link to an outside commercial system;

(2) Every school has U. S. Postal Service delivery to its facility;

(3) Telephone services and/or facilities can be expanded internally by adding one or more lines to augment or supplement traditional teaching with teleprocessing techniques.

Given these assumptions, several alternatives are possible for provision of services to the smaller schools, depending upon the nature of the instructional materials to be used. While each alternative may vary in implementation according to individual school requirements, the following will serve as examples.

Telecommunications Improvement

Narrow band (voice) telephony channels:

(1) The use of special filters to allow a single telephone line to carry speech plus duplex channels. This would permit the transmission of data via a CAI terminal that could be linked by private line to the nearest Regional Education Service Center time-sharing computer, without interfering with the normal administrative purposes of the telephone.

(2) The use of slow-scan TV recordings transmitted from a central source via telephone

lines to video (program) converter/recorders in isolated schools during "off hours" (midnight to 5 AM). It is assumed here that both price and operations requirements for such a facility could be met.

New Telecommunications Facilities

The most widely accepted method for reaching the greatest number of individuals within the state is conventional television broadcast (omni-directional) coverage using high power output transmitters. There have been several new developments in this area, involving portable, two-way microwave communications systems which can link two remote points with multiplexed voice channels, NTSC video, or digital data communications. In fact, such equipment is now commonly used in emergency or disaster situations for the restoration of communications. There are undoubtedly many firms manufacturing this type of equipment; however, the mention of one will suffice for example here: the TERRACOMM Corporation portable microwave model with provision for up to 1200 voice channels and one video channel or 12 channels of high speed digital data communications. The advantage of a portable system is that in times of emergency it can operate for a limited time (6-12 hours) on its own batteries as well as on conventional AC power. The unit can be set up very rapidly, and once it is oriented and aligned it requires very little attention during operation. Units can also be used back-to-back to extend coverage up to fifty miles (the normal operating line of sight distance is from 15 to 20 miles). The home station for such a system could be located at the nearest Regional Education Service Center, with the distant stations set up at points that could serve the schools in question. With a broadband transmission capability the system would have the flexibility for handling: (1) live programs; (2) real time remote program recording and duplication; (3) interaction of multiplexed CAI terminals with the ESC computer; and (4) two-way talk-back programs for in-service training or specialized instruction. Problems that must be considered in the use of this type of facility are: (1) acquisition costs; (2) life expectancy; (3) frequency availability and allocation; (4) maintenance; and (5) compatibility with existing CATV and ITFS systems for interoperability and switching.

Satellite Ground Stations

The use of fixed orbital satellites with inexpensive ground stations for two-way transmission of educational materials would be the ideal solution for remote school access; however, this type of facility would necessarily involve a multi-state consortium system of coverage, coordinated through a federal agency such as NASA or HEW. The concept is, however, practical, and the present state of the art would permit it to be implemented with one exception: costs of the satellite itself are almost prohibitively high (40 million dollars for a satellite such as Hughes builds for NASA, the ATS-6), although a ground station can be built for as little as $600. Attempts are being made at the present time to bring together various states, federal agencies, and other interested parties in follow-on efforts to provide an educational satellite after the ATS-F experiment terminates in India. Mr. Rex Lee, former governor of the trust territories in the Pacific and former chairman of the Federal Communications Commission, is chairing this consortium, whose meetings are scheduled to be held during 1975. Although Texas is not officially represented to date, this might be a worthwhile consideration in future planning.

The American Television and Communications Corporation is currently experimenting with the possibility of presenting commercial pay television programs via satellite relay; the ongoing project is described in greater detail in the chapter on Futures.

Other Alternatives

The current situation in Texas with regard to educational telecommunications networks is that there are many types of networks, each possessing specialized capabilities, but lacking the compatibility to operate together with the other networks in a single statewide facility. Most of the reasons for this incompatibility are technical ones, each of which must be examined in terms of systems transmission standards, and since 90% of the existing state networks are leased from one or more common carriers it is doubtful that an unbiased examination could be carried out.

Additional considerations include:

Broadband Networks. In the area of broadband (video) networks it may be feasible to study the cost of interfacing and providing a switched video channel capability between the Texas Telecomputer Grid Network, TEMP, and TAGER for program interchange as well as live broadcast of in-service teacher training programs at the various Education Service Centers. A further refinement of the switch would allow for centralized duplication of video tapes at one central source (e.g., KLRN in Austin) in order to maximize professional quality and minimize cost. Off-hour use of channels for transmission to other stations could also serve as an alternative method of program transfer.

Computer-Assisted Instruction. With the vast increase of interactive computer terminals with dial-up (switched) capability to a central processor, it is not infeasible for the same technique to be used among time-sharing mini-computers for program transfer of CAI instructional software materials via a data set switched voice line using 1200 bit per second asynchronous transmission. There is a dearth of CAI course materials in the state's elementary, junior high, and senior high schools, and the sharing of this material among Education Service Centers on a dial-up basis would be highly desirable.

Community Antenna TV (CATV). The expansion of present commercial CATV systems to independent school districts in remote areas should be investigated to see if two-way television could be used as a means of providing both video and CAI services to the Regional Education Service Centers. (The previous TEA study in this area is becoming outdated.)

True Digital Data Transmission Systems. In addition to AT&T, many of the newer common carrier firms such as DATRAN; Microwave Communications, Inc.; CPI, Inc.; American Satellite Corporation; and Western Union now offer true digital data transmission systems which use pulse code modulation (PCM) techniques, assuring extreme accuracy in transmission. These systems should be investigated in terms of lower operating costs and systems engineering practices.

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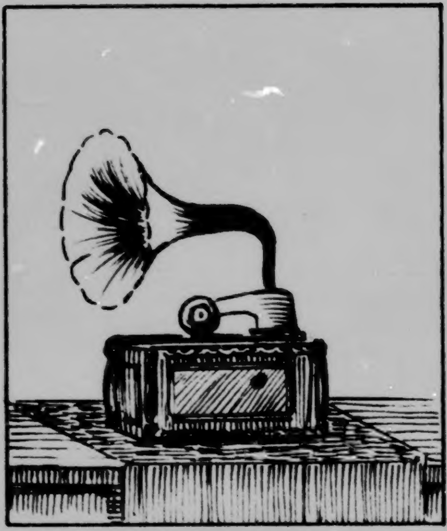
others' nets

VI



PRÉCIS

The study of technology and telecommunications being used successfully in other states could become an unwieldy undertaking, so the initial portion of this chapter narrows its focus to a few states and a few unusual types of communications.

Data about educational telecommunications are presented and discussed for the states of Alabama, Kentucky, Louisiana, and Ohio, selected because of some physical, demographic, or educational similarity to Texas.

The use of satellites in education is then discussed, with major emphasis on the ATS-6, the most recent educational vehicle in orbit. Programs for the Appalachian and Rocky Mountain areas and for Alaska are examined, and the overall impact of satellite communications on remote areas is discussed. (A map showing Texas' remote populations is included.)

A section on computer networks describes one of the best in the country, the TUCC in North Carolina. Also included is the ARPA net, with charts showing both the geographic interconnections and the electronic schematic, and discussion of the network's achievements.

A section on tethered communications describes the gas-filled, dynamic balloon (aerostat) which lifts broadcast antennas to much greater heights than the usual masts, thereby providing much greater coverage of potential receivers (nearly 50,000 square miles). The system has some shortcomings, however, and these are also discussed.

Texas is compared with several other states in terms of resources, population, and educational variables. The chapter concludes with some suggestions about methodologies in use in other states which are worth emulating.

The contents of this chapter are:

General p. VI-1
Educational Telecommunications in Other States p. VI-4
Satellite Telecommunications p. VI-16
Computer Networks p. VI-21
Tethered Communications p. VI-24
Texas--Comparisons p. VI-29
Summary and Implications p. VI-31
Bibliography p. VI-34

VI

OTHERS' NETWORKS

GENERAL

Many other states have begun to deal with the problem of developing some kind of statewide telecommunications network, and some states have actually passed beyond the developmental stage to implementation of their proposed systems. The experiences of these other states, their planning methodologies, and the solutions they have selected as most appropriate for their particular situations should be examined for their utility to Texas in planning for coordination of existing telecommunications resources. Accordingly, this section of the study comprises information gathered about telecommunications activities now going on in other states, along with some implications suggested by this information.

Prior to the study of specific networks in other states, a review was made of the systems operated, initiated, or planned by the various states. Considerable material on these systems was already available through the Texas Education Agency; however, since most of the material was from two to four years old, an effort was made to update it all. On the basis of our initial studies it appeared that (including Texas): 38 states had an educational commission which exercised a measure of control or supervision on a statewide basis over educational facilities, curriculum, and teachers; 25 states regularly (daily or weekly) broadcast in-school educational TV programs over one or more stations; 43 states had a state ETV Authority which exerted some control or supervision of statewide educational television facilities and programming; 24 of the above 43 states operated interconnected multiple transmitter ETV systems (having more than one ETV station); 7 states operated interconnected multiple transmitter educational radio systems; and 21 states were participating in satellite demonstrations. (See Figure VI-A.)

In October, 1974, a letter explaining the purpose of this study was sent to each of the other states. Similar letters were sent to the Federal Communications Commission (FCC), the Department of Health, Education, and Welfare (DHEW), the White House Office of Telecommunications, NASA, and the National Association of Radio and Television Broadcasters (NARTB), among other organizations. Briefly, our letters described the study and requested the assistance of the various agencies in providing up-to-date information concerning educational telecommunications systems and facilities, including both ongoing activities and plans for future development, that would be helpful to us. By mid-January, 1975, only 12 states, the FCC, DHEW, and NASA had replied to our request. Time did not permit the detailed follow-up that would have been required to obtain information from the 37 states that had not responded to our letter.

Of the 12 states answering the letter, Montana and Wyoming said that they had no statewide educational telecommunications facilities; Louisiana and Maryland indicated that they were in the process of implementing educational telecommunications systems; and Alabama, California, Kentucky, New York, Ohio, Pennsylvania, South Carolina, and Wisconsin provided current information on their existing multi-station educational telecommunications networks. Again, the lack of sufficient details in the information provided by some of the states and the time constraints of our contract dictated the further limitation of the study of the educational telecommunications activities of the other states.

On the basis of innovation, technological advancement, geographic comparability, and size of the network involved, the decision was made to limit this section of the study to an

EDUCATIONAL TELECOMMUNICATIONS IN THE UNITED STATES

STATE	Educational Commission	Educational Programming	Educational TV Authority	Educational TV Systems (Statewide)	Radio Systems (Statewide)	Satellite Use	STATE	Educational Commission	Educational Programming	Educational TV Authority	Educational TV Systems (Statewide)	Radio Systems (Statewide)	Satellite Use
Ala	x	x	x	x		x	Mont*	x		x			x
Aka	x		x			x	Nebr	x	x	x	x		
Ariz	x		x			x	Nev	x		x			x
Ark	x	x	x				N H		x	x	x		
Cal*			x	x	x		N J	x		x			
Colo			x			x	N Mex	x		x			x
Conn		x		x			N Y*	x	x	x	x	x	x
Dela	x		x	x			N C		x	x	x		x
Fla	x		x		x		N D	x		x		x	
Ga	x	x	x	x		x	Ohio*	x	x	x	x		
Haw		x	x	x		x	Okla	x	x	x	x		
Idaho			x			x	Ore	x	x	x	x		
Ill							Penn*	x	x	x	x		x
Ind	x	x	x	x			R I	x	x	x			
Iowa	x	x	x		x		S C*	x	x	x	x		
Kan							S D	x	x	x	x		
Ky*	x	x	x	x		x	Tenn	x	x	x	x		x
La*	x		x				Texas	x					
Maine	x	x	x	x	x		Utah	x	x	x	x		x
Md*	x	x	x	x		x	Vt	x	x	x	x		
Mass	x						Va	x		x			x
Mich							Wash	x		x			x
Minn		x					W Va	x		x			x
Miss	x		x				Wisc*	x		x	x	x	
Mo							Wy*	x		x			x
							TOTAL	38	25	42	24	7	21

*Provided current information on their state-wide educational system.

Figure VI-A

examination of what we deemed a representative sampling: the telecommunications facilities of the states of Alabama, Kentucky, Louisiana, and Ohio; the joint NASA/DHEW program using the ATS-6 satellite for health and education experiments in the Appalachia, Rocky Mountain, and Northwest regions of the country; and the computer network for higher education in North Carolina. Although they do not comprise an active delivery system within any state at the present time, the section also examines and describes tethered communications (TCOM), a product of TCOM Corporation, a subsidiary of Western Electric Corporation.

Definitions

Instructional television (ITV). This term refers to all materials presented via television to organized classes, regardless of grade level or physical location. ITV may be broadcast in one form or another; distributed by closed circuit television; or distributed by video tape and cassettes. (Gulf South Research Institute, 1973)

Noncommercial television (NCTV). This term refers to programs broadcast by UHF or VHF stations which are licensed as noncommercial stations and whose revenues are derived primarily from public sources. NCTV has a three-fold role:

(1) To offer instructional programs on the elementary, secondary, and college levels, including adult education, vocational-technical education, and extension service programs.

(2) To present public affairs programs that inform the public about critical social issues, or present new knowledge and/or technology.

(3) To enrich and enlarge the cultural and artistic horizons of the public by providing exposure to the works of gifted authors, artists, composers, musicians, and others. (Gulf South Research Institute, 1973)

Educational television (ETV). This term normally refers to ITV and NCTV; thus, the definition is in essence identical to the broad one given for NCTV above. (Gulf South Research Institute, 1973)

Public broadcasting service (PBS). PBS was preceded by National Educational Television (NET), which began operations as the Educational Television and Radio Center, an Illinois corporation established in 1952. In 1954, the Center was moved to Ann Arbor, Michigan. NET was originally designed to serve as an exchange center for programs produced by member stations; later, however, other program sources were included. The Public Broadcasting Act of 1967 led to the establishment of the Corporation for Public Broadcasting (CPB), which initially coexisted with NET. Upon absorbing NET in 1969, the Corporation for Public Broadcasting established the Public Broadcasting Service (PBS), which is now the sole nationwide interconnected program service for noncommercial stations. PBS has recently completed the interconnection of all member NCTV stations, and has the capability to provide programs on a 24-hour-a-day basis. The addition of other interconnections will depend upon federal funding levels. (Gulf South Research Institute, 1973)

Closed circuit television (CCTV). This term refers to a private, closed circuit cable line owned or leased by the user for distribution of signals within the limits of the owner's property. CCTV is used, for example, to carry signals from one building to another on school campuses. The signal usually either comes from video tape or is produced live at a given location. However, it is also possible to receive broadcast signals and distribute them through CCTV. (Gulf South Research Institute, 1973)

Community antenna television (CATV). This term refers to the transmission of television signals by line or cable from a signal entry point to a home, office, or campus. A monthly rental charge is usually levied for this service. CATV does not originate programs, but only transmits existing signals. Distant signals as well as signals of local origin may be transmitted, and the service usually includes several signals, among which the user may make frequent changes. (Gulf South Research Institute, 1973)

Instructional Television Fixed Service (ITFS). This term refers to the frequency range of 2500-2690 megahertz. There are 31 channels within this range open for educational and other institutions. The Federal Communications Commission (FCC) limits ITFS signal power; therefore, the transmission distance is relatively short (five to twenty miles). To receive ITFS signals, a special receiving antenna and converter are necessary. ITFS may be characterized generally as point-to-point transmission, in contrast to the omni-directional broadcasting of commercial TV stations. (Gulf South Research Institute, 1973)

Computer-assisted instruction (CAI). This is the technique of using a computer program, together with necessary central and terminal equipment, to aid the student in the learning process. It usually deals with a form of individualized instruction; most instructional programs are designed to permit the student to progress at his own best rate, and to have the computer keep records of each student's progress and standing. (Higginson, Swanson, and Love, 1969)

Computer-managed instruction (CMI). This is a method of using a computer, not only for instruction of the student, but also for handling performance records, handling curriculum files, grading tests, etc. Also the computer may be used for scheduling of non-computer media and teaching processes by automatic data processing techniques. In short, the computer performs many tasks of a management nature for the teacher, as well as performing most of the functions of CAI. (Adapted from Higginson, Swanson, and Love, 1969)*

EDUCATIONAL TELECOMMUNICATIONS IN OTHER STATES

Alabama

Educational telecommunications facilities in the state of Alabama include a 12-station public broadcasting system extended by 26 community antenna television (CATV) systems, under the direction of the state of Alabama Educational Television Commission, and eight ITFS systems, which are operated in support of the Jefferson County Board of Education (2 systems), the Board of Education of Birmingham (2 systems), the Etowah County Board of Education at Gadsden (2 systems), the City Board of Education of Huntsville (1 system), and the Board of Trustees for the University of Alabama (1 system).

Created by the State Legislature in 1953, the Alabama Educational Television Commission (AETC) has the responsibility for the growth and development of a free and effective public television service in Alabama. Five commissioners are appointed by the governor and approved by the state Senate. No two commissioners may reside in the same congressional district and each serves for a term of ten years, with the terms overlapping. The commission is responsible for the operation of the entire network, including programming, engineering, and public information activities.

Network description. Physical facilities of the Alabama Public Television (APTV) system include nine transmitters, three translators,** seven production studios, 26 community antenna television (CATV) systems extended to 16 counties, approximately 2,000 miles of state-owned and state-operated microwave link, and two color remote vans owned and operated by the APTV and available for use by all stations. The nine transmitters and three translators are all licensed to the Alabama ETV Commission. (See Figure VI-B.)

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*Further references for this chapter are grouped by section at the end of the chapter.

**A relatively low power facility for providing services to a limited area. A translator cannot originate programming, but can only repeat the signals it receives from a television station, by amplifying them and changing their frequency ("translating" them) to another channel for re-broadcast. The facility functions automatically, and thus can be operated unattended. (Gulf South Research Institute, 1973)

ALABAMA EDUCATIONAL TELECOMMUNICATIONS

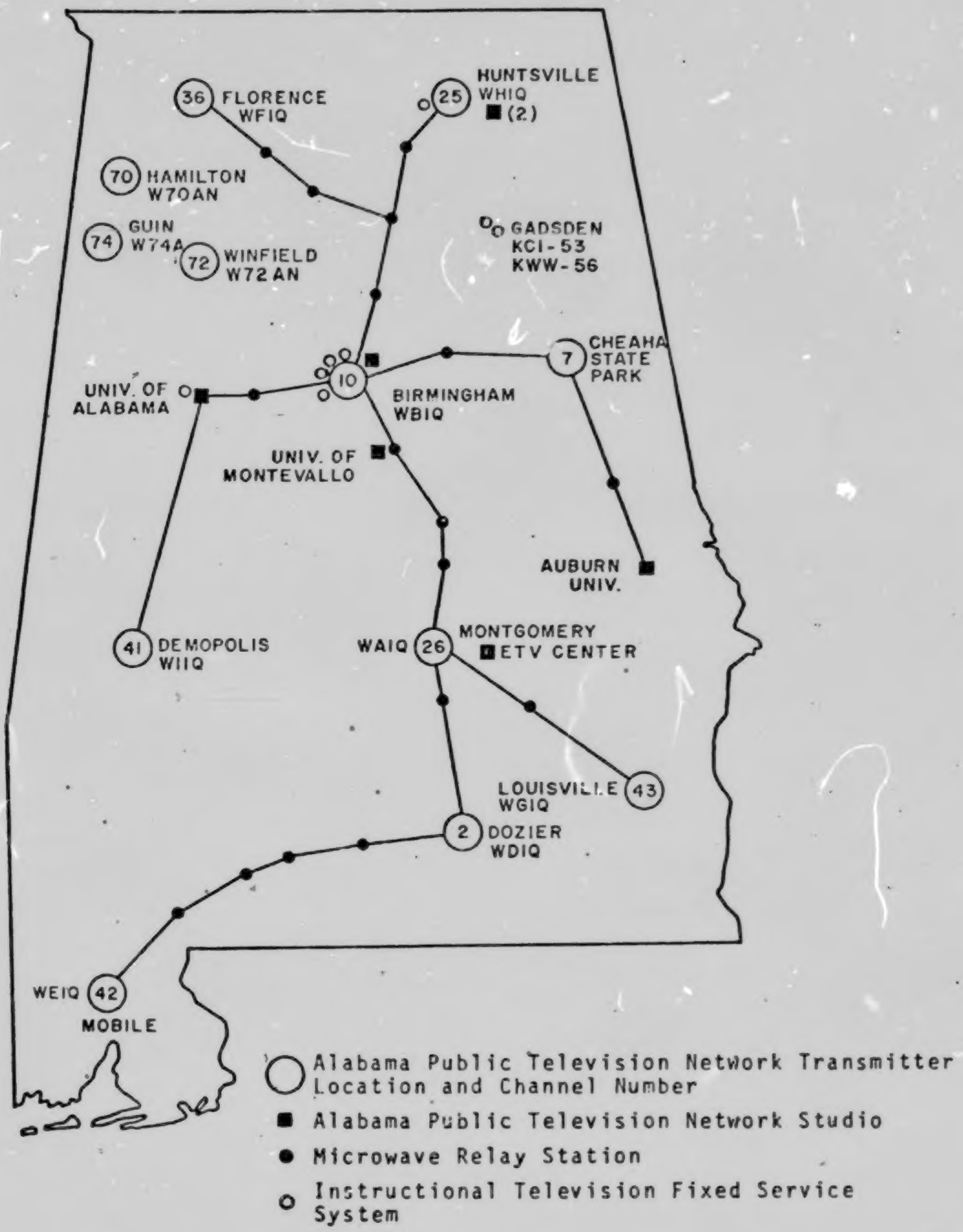

36 FLORENCE WFIQ
25 HUNTSVILLE WHIQ
(2)
70 HAMILTON W70AN
74 GUIN W74A
72 WINFIELD W72AN
GADSDEN KCI-53 KWW-56
10 BIRMINGHAM WBIQ
7 CHEAHA STATE PARK
UNIV. OF ALABAMA
UNIV. OF MONTEVALLO
AUBURN UNIV.
41 DEMOPOLIS WIIQ
WAIQ 26 MONTGOMERY
ETV CENTER
43 LOUISVILLE WGIQ
2 DOZIER WDIQ
WEIQ 42 MOBILE
○ Alabama Public Television Network Transmitter Location and Channel Number
■ Alabama Public Television Network Studio
● Microwave Relay Station
○ Instructional Television Fixed Service System

Figure VI-8

The network staff includes general manager, assistant manager, director of programming, assistant program director, director of records and bookkeeping, director of engineering, assistant engineering director, director of promotion, traffic director, three network headquarter engineers, two district engineering supervisors, three microwave engineers, 40 engineers, nine transmitter specialists, and seven secretaries. There are approximately 200 employees connected with the seven studios.

Network programming. The final responsibility for making program schedule decisions rests with the Director of Programming for the Alabama Public Television Network (APTN). The ITV Coordinator in the State Department of Education (SDE) provides to the Director of Programming each year a schedule of ITV programs which are in accordance with the SDE prescribed course of studies in the classroom. The SDE and APTN undertake constant evaluation and review in order to up-date all ITV programs, by replacing individual programs within a series, by redoing the series, or by providing new television material as need or interest arises. The ITV Coordinator of the SDE and the APTN have a four year development and review plan, thus allowing adequate production time for a new ITV series. Ninety-seven percent of the total area of the state can receive the signal telecast by the APTN, which operates from 8:00 AM to 11:00 PM Monday through Saturday, and from 1:00 PM to 11:00 PM on Sunday. The summer schedule is much the same except that there is no in-school schedule; therefore, sign-on Monday through Friday is at 2:00 PM. This schedule starts on June 1st and ends on September 1st of each year. The in-school schedule runs from September to June of each year, with operating hours from 8:00 AM to 3:00 PM Monday through Friday.

About fifty-five percent of the programming is produced locally in Alabama studios; the balance is provided by program acquisition and PBS. There are no TV teachers allocated to the production studios, nor are there any on the payroll. TV teachers are used on an individual basis, depending on the needs of a particular series, and are provided from a "class" of teachers capable of teaching the subjects or series in question. They work on a reduced time basis and then return to classroom duties when they are finished. With production studios situated throughout the state, teachers with particular skills are cataloged and assigned according to specific geographic locations. Software specialists are provided by the SDE to meet the needs of the studios.

Funding. The Alabama fiscal year starts on October 1st, with funding on a biennium basis.. Financial support for the APTN is provided through state legislature appropriations. APTV does not hold auctions nor sell subscriptions to raise funds, but does receive occasional grants for equipment from the Department of Health, Education, and Welfare, which provided $700,000 in the biennium 1973-1974. A CPB Community Service Grant of $163,000 was also received in this time period. Capital investment in the APTN facilities is $5 million for hardware; the total system is worth $40 million. The operating budget for the biennium 1972-1973 was $1.5 million, with $2.005 million allocated for the biennium 1974-1975 and $4.794 million for 1976-1977.

Future plans. There are no plans to expand the system. Current plans call only for the system to be upgraded, since most of it is about 21 years old and hence outdated. The projected biennium budget for 1976-1977 includes a request for $600,000 for the replacement of two TV transmitters; however, Mr. R. E. Dod, General Manager of APTN, was not confident that the funds would be approved. Mr. Dod also advised of plans to replace all TV cameras with color cameras in order to be competitive with other programs.

Effectiveness of network. The APTN reports experiencing serious problems with the UHF frequencies assigned. These problems are caused by the signals being blanked out in the mountainous areas of the northern part of the state; resolution will require the addition of more translators. A cable system is currently being built into the city of Jackson, where a translator will be installed.

The APTN is now viewed by over 500,000 students in 1,050 school buildings who watch at least one network program weekly. In some cases, students may watch two or more programs, but statistics on this are not available. The APTN is audited about every two years.

ITFS systems. The ITFS systems operated within the state are not part of the APTN; however, the stations all receive video-taped APTN programming on an open-circuit pickup for retransmission within their own systems on a time delay basis. This procedure has the concurrence of the Alabama Educational Television Commission and is specifically authorized in the enabling legislation of the AETC. In addition, the studios of three of the ITFS systems are under contract to the APTN. ITFS systems operate within the state as follows:

(1) The Birmingham School System operates one originating station (KZW-56) and one relay station (KLC-77), transmitting 105 hours a week from two studios, over four channels, to 96 school buildings. Ten percent of the programming is local. Programming includes direct instruction, supplementary instruction, enrichment, in-service education, film distribution, administration, and seminars. Four part-time TV teachers are used. The total plant investment is $512,309, and the yearly operating expense comes to $75,000.

(2) The Jefferson County Board of Education operates one originating station (KIP-47) and one relay station (KIP-49), transmitting 50 hours a week from one studio, over two channels, to 89 school buildings. The programming, less than ten percent of which is local, is viewed by 36,000 students in 956 classrooms. Programming includes supplementary instruction, in-service education, film distribution, administration, and seminars. Total plant investment is $325,000; yearly operating expense is $65,000.

(3) The Etowah County Board of Education (Gadsden) operates one originating station (KCI-53) and one relay station (KWV-56), transmitting 15 hours a week from one studio, over two channels, to five school buildings. More than 75 percent of the programming is local, and it is viewed by 4,000 students. Programming includes supplementary instruction, enrichment, in-service education, and seminars. There are five full-time TV teachers. The total plant investment is $182,863, and the annual operating budget is $210,600.

(4) The Huntsville Board of Education operates one originating station (KHU-75), transmitting 75 hours a week from one studio, to 29 school buildings. Between 10-25 percent of the programming, which is viewed by 30,000 students in 950 classrooms, is local. Programming includes supplementary instruction, direct instruction, enrichment, total teaching, in-service education, film distribution, orientation, administration, and seminars. Two full-time and two part-time TV teachers are used. The total plant investment is $278,300; the annual operating budget is $80,000.

(5) The Board of Trustees of the University of Alabama operates one originating station (WBN-31) on campus to classrooms of the University of Alabama at Birmingham. Total plant investment is $80,987, with an annual operating budget of $33,500.

Kentucky

Educational telecommunications facilities in the Commonwealth of Kentucky include: an 18-station educational television network interconnected by closed circuit links with 13 community colleges and seven university studios, under contract by the Kentucky Authority for Educational Television to the State Board of Education, and two ITFS systems, operated in support of the Owensboro Vocational School and the Board of Education of Paducah Independent School District.

The Kentucky General Assembly, in 1962, passed bills authorizing the State Board of Education to lease educational television facilities from the Kentucky Property and Building Commission; enabling that commission to issue revenue bonds for the purpose of constructing ETV facilities; and establishing the Kentucky Authority for Educational Television, a public agency and instrumentality of the Commonwealth, which operates these facilities by contract with the State Board of Education. The Kentucky Educational Television Network (KET) was commissioned in 1968.

Network description. The KET includes 13 transmitter sites; five translator sites; a 35,000 square foot Network Production Center (NPC), located in Lexington on land donated by the University of Kentucky; and seven college and university studios interconnected with 13 community colleges and the KET network NPC by closed circuit network links. Distribution of the TV signal from the NPC to all transmitters and the closed circuit network is through contract with the common carrier. The KET can be segmented into five separate regional feeds. (See Figure VI-C.)

Network programming. Programming is under the direction of the Kentucky Board of Education (BOE). About ten percent of the programming for the KET is generated within the state. Approximately 98 percent of this local programming is generated by and from the NPC, with the seven university studios, which are used almost exclusively for on-campus programs, contributing not more than two percent of the network programs. PBS network programs account for about 33 percent of total state programming. The balance (about 57 percent) is shared between program acquisition (tapes and cassettes) and in-school programs.

Each of the 13 universities has been or will be given $200,000 worth of studio equipment by the Authority, under the condition that each provide a suitable studio and an adequate staff, subject to Authority approval. Use of the studios will be determined by each of the schools, but service to the campus and training of future teachers is of paramount importance to the Authority.

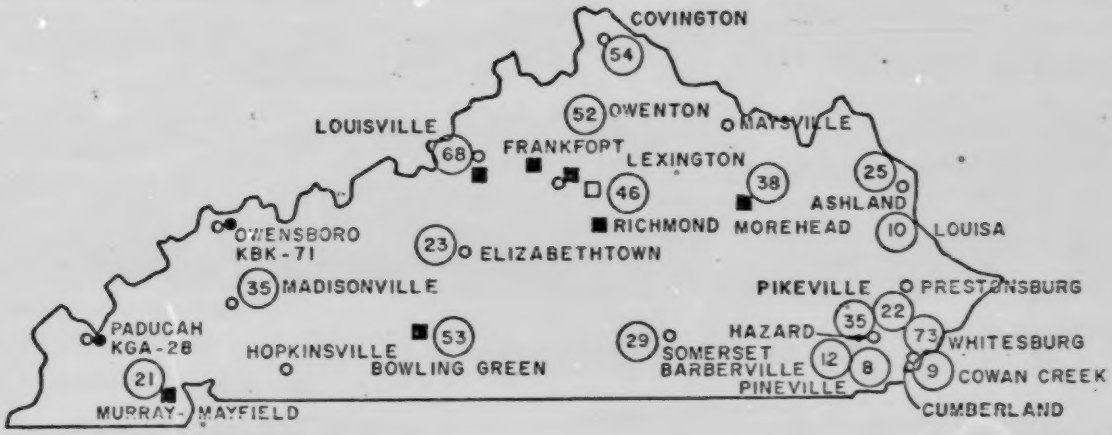
The KET provides instructional programs designed to supplement local teaching in nearly 1,400 schools located in more than three-quarters of the state's 195 school districts. All programs are carried statewide, and can be seen in homes and schools over VHF and UHF outlets. The KET has a first and absolute commitment--aid to the classroom teacher. Educational programs for the Network concentrate, for the most part, on the elementary and secondary school levels, although there is also a full schedule of daytime programs for the pre-schooler. Programs are provided in all subjects for which support is critically needed--science, social studies, foreign language, music, art, literature, history, and government. Late afternoon programs include college credit courses, courses for continuing professional education in fields such as medicine, law, and business, and children's programs such as "Sesame Street." Programming is also available in the areas of vocational training, literacy training, and employment information; additional coverage includes health, public safety, enrichment programs, and in-depth reports on national and world affairs.

The Department of Education has a field staff of five people who travel constantly throughout the state, conducting workshops and doing some work with teachers on a one-to-one basis. These activities comprise the primary utilization efforts toward in-service training. About 70 to 80 percent of the student teachers are taking classes in instruction about the KET, held at the NPC headquarters in Lexington and lasting approximately 2 to 3 hours each.

Funding. Financial support for the KET itself is provided by the issuance of bonds, by Commonwealth General Assembly appropriation, and by HEW grants. Each individual school provides its own antennas, converter, and internal distribution system. Capital investment in the KET is $10.7 million. The FY 1975 (effective July 1, 1974) operating budget is $3.7 million, with the budget for FY 1976 projected at $4.0 million.

Future plans. The KET is designed to be the backbone of an expanded telecommunications system, with provisions presently existing for two transmitters at every station site. KET will eventually become a 26-station operation, with a second bank of outlets that will beam courses primarily to high schools and to adults studying at home.

KENTUCKY EDUCATIONAL TELECOMMUNICATIONS


COVINGTON
54
52
OWENTON
MAYSVILLE
LOUISVILLE
68
FRANKFORT
LEXINGTON
38
25
46
ASHLAND
RICHMOND
MOREHEAD
10
LOUISA
OWENSBORO
KBK-71
23
ELIZABETHTOWN
35
MADISONVILLE
PIKEVILLE
PRESTONSBURG
22
35
PADUCAH
KGA-28
53
29
HAZARD
73
WHITESBURG
HOPKINSVILLE
SOMERSET
12
8
9
21
BOWLING GREEN
BARBERVILLE
COWAN CREEK
PINEVILLE
MURRAY
MAYFIELD
CUMBERLAND

◯ Kentucky Educational Television Transmitter Location and Channel

□ Kentucky Educational Television Network Production Center

■ Kentucky Educational Television College and University Studio

○ Kentucky Educational Television Community College

● Instructional Television Fixed Service System

Figure VI-C

Effectiveness of the network. Mr. O. Leonard Press, Executive Director of KET, advises that they are having technical problems with the UHF frequencies. Kentucky has joined a UHF lobby in Washington to encourage granting of educational frequencies in the lower frequency spectrum. The problems with the UHF frequencies are primarily due to complete blockage of the signal in the mountainous areas. A parallel problem is posed by the orientation of the antennas; this problem is a continuing one, with complete resolution improbable.

Mr. Press was extremely pleased with the favorable response by school administrators and teachers to the KET. He stated that 95 percent of the schools are now tied to the KET and that they are totally committed to the system. The five percent of the schools uncommitted are primarily those which are unable to receive the KET signal.

ITFS systems. ITFS systems operate within the Commonwealth of Kentucky as follows:

(1) The Owensboro Vocational School operates one originating station (KBK-71) transmitting from one studio over two channels to 10 school buildings, and viewed by approximately 3,000 students in 100 classrooms. Between 25-50 percent of the programming is local; programming includes supplementary instruction, enrichment, in-service education, film distribution, and orientation. TV teachers are not used. The total capital investment was $289,000, and the annual operating budget for 1971 was $14,306.

(2) The Board of Education of the Paducah Independent School District operates one originating station (KGA-28), transmitting 22 hours a week from one studio over four channels to 14 school buildings, and viewed by 5,000 students in 161 classrooms. Less than ten percent of the programming is local. Programming includes enrichment, total teaching, in-service education, testing, orientation, and film distribution. TV teachers are not used. The total capital investment was $158,224; the annual operating budget for 1971 was $45,250.

Louisiana

Educational telecommunications facilities in the state of Louisiana include: the Louisiana Educational Television Network (LETN) run by the Louisiana Educational Television Authority, with facilities that are just becoming operational; and one ITFS system in support of the State Board of Education at the University of Southwestern Louisiana in Lafayette.

In 1971, the Louisiana Legislature passed an act authorizing the establishment of the Louisiana Educational Television Authority (LETA). This Authority may lease, purchase, construct, own, operate, manage, and be the licensee of educational and public television and radio stations, production centers, and all related equipment and facilities for the production and/or transmission of open circuit, closed circuit, and any other means necessary to provide complete network coverage. The Act also provided for the consolidation of all existing state agency telecommunications networks and directed that they be placed under the direction of the LETA.

Network description. The Louisiana Educational Television Network will eventually include four UHF and two VHF stations; one UHF translator; a production center in the Department of Education building in Baton Rouge; TV studios, currently partially completed, at 14 universities and colleges throughout the state; one mobile studio; a closed circuit TV loop connecting the Department of Hospitals in Baton Rouge with the ten charity hospitals of the state; and closed circuit microwave and other related facilities. Currently, the LETN includes the production center in Baton Rouge and the 14 partially completed studios in the universities and colleges of the state. The first station, channel 27, Baton Rouge, was scheduled to be commissioned in May-June 1975. Effective July 1, 1975, the ten charity hospitals and the Department of Hospitals studio, incorporated in the closed circuit hospital loop, were to be integrated into the LETN. Before September 1975, channel 27 will be interconnected with channel 12, New Orleans, and the latter station will be brought into the LETN. Monroe, channel 13, will probably be commissioned in November, 1975, followed by Shreveport in March, 1976. The rest of the stations scheduled for inclusion in the LETN will be commissioned in accordance with a schedule still to be determined. (See Figure VI-D.)

Network programming. The State Department of Education (DOE) will have sole responsibility for and control over the preparation, content, and programming of all instructional television programs used to supplement elementary and secondary education curricula in the schools of the state, and will have priority as to the scheduling of television during school hours. Initial planning calls for programming ten hours a day, six days a week, starting in September, 1975, with about five percent of this programming to be live. All the ITV programming will be on videotape. The DOE plans to use TV teachers, but has no firm figures for the total number to be employed when the system is fully implemented. DOE is currently producing a series of 18 fifteen-minute bilingual/bicultural programs, centered on the "Acadian" part of the state. Heaviest emphasis in the months to come will be on programming for K-7 (estimated at from 63 to 65 percent of the total programming), with the balance concentrated primarily on grades 8-11 and smaller amounts of programming for grade 12 and the university levels. DOE plans to provide full color capability to the college studios at the earliest possible date, with provision for them to produce their own programs for campus and network presentation, although it should be noted here that the College Board is responsible for all college level courses.

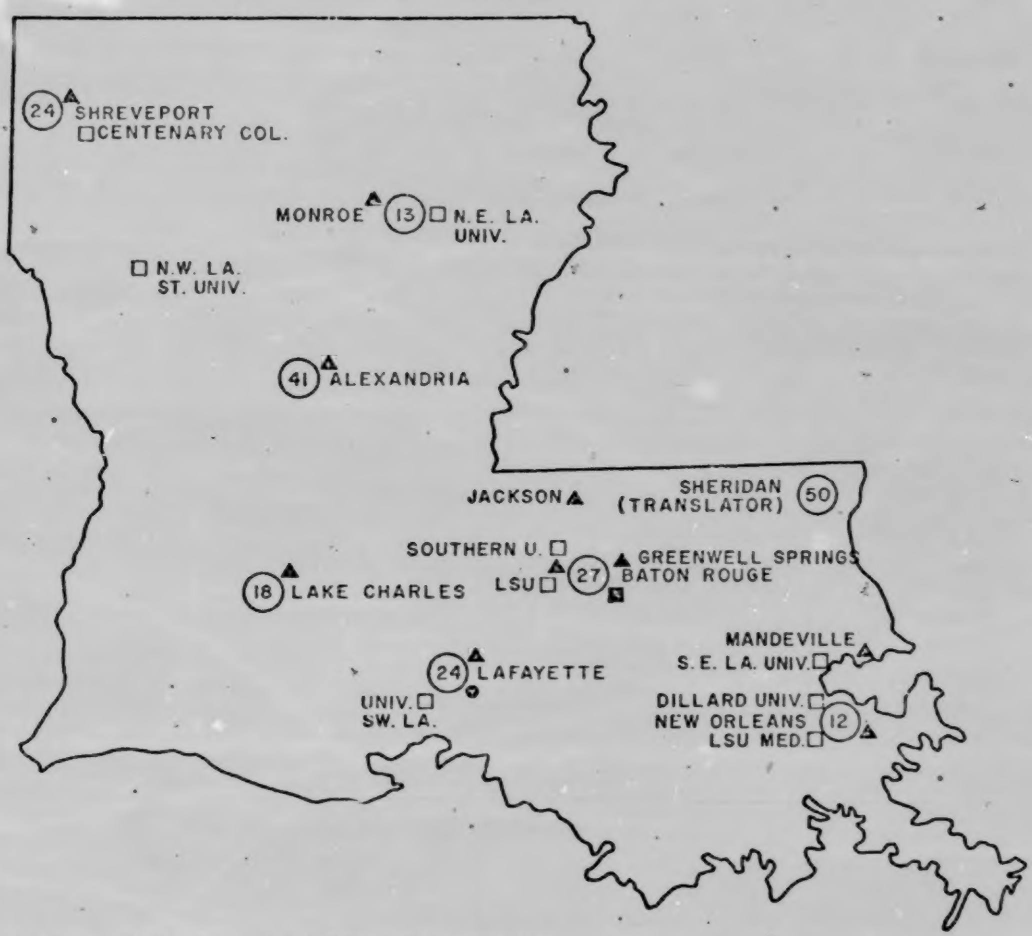
The Louisiana Educational Television Authority (LETA) will have responsibility for and control over all public television programming. Initially, not more than six to seven percent of the ITV and public programming will be produced locally and distributed on video tape. Sixty-five to seventy percent of the public programming will be provided by PBS and the Southern Educational Communications Association (SECA).

The Department of Hospitals (DOH) will have responsibility for and control over the preparation, content, and scheduling of all health and medical programming. The DOH presently has a regular in-service training schedule for nurses, interns, and doctors. Programming can originate from any of the ten charity hospitals; however, most of the programming comes from the Department of Hospitals in Baton Rouge, with a small amount from the Earle K. Long Hospital there.

Funding. The 1972 Legislature authorized the State Bond Commission to issue up to $6.1 million in general obligation bonds to provide the state's share of capital funds for the LETN. DHEW will match the funds provided by the state, so that the total capital investment will be $12 million. FY 1975 operational funds (available July 1, 1974) for the Baton Rouge station (channel 27) were estimated at $35,260, with another $549,904 for the production center. Operational funding for the LETN in FY 1976 is $2.5 million. This funding includes $1 million from the DOE, and provides "seed money" for one TV monitor in each school, salaries for an ITV Utilization Team, money to purchase TV programs, and materials for training purposes (e.g., video tape machines). The DOE is also seeking federal funds for the purchase of additional equipment. One problem that has recently surfaced concerns a re-ordering of the priorities for federal matching funds by DHEW. Mr. O. Pat Morgan, Program Development Coordinator of LETA, says that DHEW currently gives first priority to updating existing facilities, with a lower priority assigned to the building of new facilities. This recent change in DHEW policy has made LETA rather hesitant and a little anxious about obtaining matching funds in accordance with state needs. LETA is currently considering going to the state legislature, after the current budget hearings are completed, and asking for the necessary funds with the recommendation that the legislature not wait for DHEW.

Future Plans. LETA is exploring the possibility of a consortium of colleges for the purpose of scheduling the campus programming somewhat along the lines of the commercial networks, i.e., providing local blocks of prime time for use as appropriate to satisfy community needs. LETA has no current plans for expanding the LETN beyond those which are now being implemented.

LOUISIANA EDUCATIONAL TELECOMMUNICATIONS


24 SHREVEPORT
CENTENARY COL.
MONROE
13 N.E. LA. UNIV.
N.W. LA. ST. UNIV.
41 ALEXANDRIA
JACKSON
SHERIDAN (TRANSLATOR) 50
SOUTHERN U.
GREENWELL SPRINGS
27 BATON ROUGE
LSU
18 LAKE CHARLES
MANDEVILLE
S.E. LA. UNIV.
24 LAFAYETTE
UNIV. SW. LA.
DILLARD UNIV.
NEW ORLEANS 12
LSU MED.

○ Louisiana Educational Television Network Transmitter Location and Station Number

▣ Louisiana Educational Television Network Operations Center

☐ Louisiana Educational Television Network Studio

● Instructional Television Fixed Service Station

▲ State Charity Hospital

Figure VI-D

Effectiveness of Network. Data on the LETN is not available. A 1971 survey by Gulf South Research Institute indicated increasing use of CCTV and ITV involving more than 8,[illegible]0 students, with more use expected in subsequent years by eight of the eleven universities surveyed. Faculty interest in CCTV and ITV was rated high by the same eight schools. Similar results are expected when the LETN is fully implemented.

ITFS systems. The single ITFS system operated by the State Board of Education at the University of Southwestern Louisiana has one originating station which transmits programming on one channel to the campus buildings and is viewed by 4,303 students. The GSRI survey referenced above indicated that greater use of TV was projected for the future. Faculty interest was also rated high for the ITFS. When the LETN station at Lafayette is commissioned, the programming will be extended to the ITFS station by cable. Total plant investment is $129,000, and the FY 1975 operating budget is $40,000.

Ohio

The educational telecommunications systems in the state of Ohio include ITFS systems operated by the University of Cincinnati, the Mount Vernon City Schools, and the Parma Board of Education, Parma City School District; a 12-station open circuit educational television network; and a four-station closed circuit hospital television network. The stations are all independently operated and funded. The Ohio network differs from those of other states in that a legislative commission charged with responsibility for the network was not established until after several stations had already been commissioned. In addition, this Commission is charged with coordinating these autonomous activities.

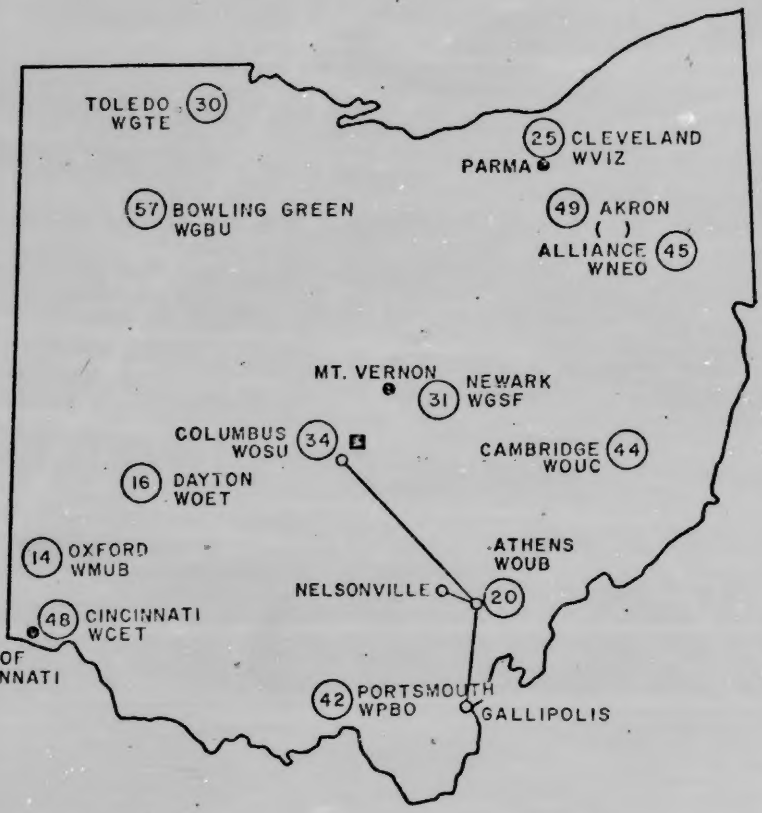
Established by the General Assembly of the State of Ohio in 1961, the Ohio Educational Television Network Commission consists of eleven members, one of whom is the State Superintendent of Public Instruction and another of whom is the Chancellor of the Ohio Board of Regents. The other nine members are appointed by the Governor with the advice and consent of the Senate. The term for each member is four years. All serve without pay but are reimbursed for actual and necessary expenses while on official business of the Commission. The Commission is authorized to own and operate, or to contract for, transmission and interconnection facilities for an educational television network; to establish standards for interconnection facilities used by the Commission; to enter into agreement with noncommercial ETV stations for transmission to the stations of identical programs for broadcasting either simultaneously or through the use of transcription discs, tapes, or film; and to determine programs to be distributed through the Ohio Educational Television Network (OETN).

Network description. The OETN includes 12 working channels licensed to colleges, universities, school districts, and educational television foundations; one more channel (channel 49, Akron) to be activated; a closed circuit television network connecting the Ohio State University hospital in Columbus with the hospitals in Athens, Nelsonville, and Gallipolis; and a Network Operations Center (NOC), centrally located in Columbus. (See Figure VI-E.) The NOC serves to collect television signals from any of a variety of sources, both in-state and out, and to distribute them from border to border, making statewide coverage a reality. The NOC is designed not only to provide simultaneous signals to all stations, but also to record and store programs for later broadcast at each station's convenience, and to assist in dubbing, editing, and assembly of video tapes, films, and slides.

Network programming. Daytime programming on Ohio network stations is primarily dedicated to in-school telecasts and is scheduled in accordance with the wishes of each station's instructional TV foundation, which is made up of school teachers and executives, and an ITV coordinator from the station. Programs in mathematics, literature, social studies, science, physical education, and art, designed for grade levels K-12, are included in each station's daily schedule.

While educational and instructional TV are its primary concern, the network also is involved in the Ohio Valley Microwave Television System, which connects hospitals in

OHIO EDUCATIONAL TELECOMMUNICATIONS


TOLEDO 30
WGTE
57 BOWLING GREEN
WGBU
25 CLEVELAND
WVIZ
PARMA
49 AKRON
( )
ALLIANCE 45
WNEO
MT. VERNON
31 NEWARK
WGSF
COLUMBUS 34
WOSU
CAMBRIDGE 44
WOUC
16 DAYTON
WOET
14 OXFORD
WMUB
ATHENS
WOUB
NELSONVILLE
20
48 CINCINNATI
WCET
UNIV. OF
CINCINNATI
42 PORTSMOUTH
WPBO
GALLIPOLIS

◯ Ohio Educational Television Network Transmitter Location and Station Number

■ Ohio Educational Television Network Operations Center

○ Ohio Valley Microwave (Closed Circuit) Hospital Television Network

● Instructional Television Fixed Service Station

Figure VI-E

Gallipolis, Athens, and Nelsonville by closed circuit TV with the University Hospital in Columbus via the Ohio Network's microwave link between Athens and Columbus. The system provides an immediate, comparatively low-cost means of securing the advice of a distant specialist for a diagnosis or in the event of an emergency when timing is critical. It also provides a means for the continuing education of health professionals who otherwise would have to use valuable time travelling long distances to attend seminars, conferences, and formal courses in order to keep up to date with the rapid advances occurring in medicine.

In the relatively short time it has been in existence, the NOC has received numerous requests from other state agencies for assistance in planning programs. The proposals have ranged from developing training films for National Guardsmen to orienting new employees, making state recreational areas better known, and rehabilitating wayward youths. Additionally, individual stations telecast their city council meetings or local high school sporting events. They also air "how-to-do-it" programs on cooking, sewing, auto mechanics, flying, and gardening. They both originate their own programs and acquire programs from the Ohio Network, from other Ohio stations, or from national and regional networks or libraries. The Public Broadcasting Network is one such source which provides the bulk of programming seen each evening on most stations. Many of the instructional telecasts aired on network stations are produced by the affiliates; others are obtained from other state agencies or from other states.

Network funding. Capital funding information is incomplete since the stations are all independently owned. Available information shows Dayton (station WOET, channel 16) funded at $631,000; Lima-Bowling Green (station WGBU, channel 57) at $700,000; Portsmouth (station WBPO, channel 42) at $729,000; Cambridge (station WOUC, channel 44) at $741,812; Columbus (station WOSU, channel 34) at $522,722; Alliance (station WNEO, channel 45) at $861,000; and the Network Operations Center in Columbus at $875,708. Operational funding for the Network is on a biennial basis. The budget for the biennium 1974-1975 is $1.8 million, which includes $300,000 for maintenance of the microwave system.

Future plans. These plans include the addition of translators in the southeastern part of the state to overcome signal loss in the mountainous regions there. No date was given for implementation.

Network effectiveness. Effectiveness has not been formally determined, although Mr. Dave L. Fornshell, Executive Director of the Ohio Educational Television Network Commission, feels that the Ohio network has been well received by the schools and the communities.

ITFS systems. ITFS systems within the state which operate separately from the OETN are set up as follows:

(1) The Board of Directors of the University of Cincinnati operates one station (KHX-47) for 12 hours a week over one channel, from two studios, to five school buildings on campus. More than 75 percent of the programming is local and comprises enrichment programs and in-service training. The total plant investment is $17,054, and the annual operating cost is $47,371.

(2) The Mount Vernon City Schools operate one station (KVT-69). Programming information for the station is not available. The total plant investment is $12,900; the annual operating cost is $10,000.

(3) The Parma Board of Education, Parma City School District, operates one originating station (KNZ-60) and one relay station (WGM-96) 43 hours a week from one studio, over one channel, to 30 school buildings. Programming is viewed by 25,000 students in 210 classrooms; three TV teachers are used. The programming, more than 75 percent of which is local, includes supplemental instruction, direct teaching, enrichment, in-service training, testing, film distribution, orientation, administration, and seminars. The total plant investment is $200,000, and the annual operating budget is $90,000.

SATELLITE TELECOMMUNICATIONS

NASA's Applications Technology Satellites (ATS) comprise one of the largest groups of a single class of satellites to be spaceborne at the same time. The ATS satellites allow for numerous different space and earth studies as well as for experimentation with advanced satellite communications technologies. Four experiments which are applicable to this study involve the use of the ATS-1, ATS-3, and ATS-6 satellites to demonstrate the principle that space vehicles can do certain complex, large-scale jobs that cannot be performed as well, if at all, by earth-based systems.

Basically, these four experiments are intended to demonstrate the feasibility of using ATS-1, ATS-3, and ATS-6 satellites to beam audio and video signals directly to hospitals, schools, and communities in isolated mountainous areas of the United States. (See Figures VI-F and VI-G.)

(1) In the Appalachian Mountain region, elementary and secondary school teachers receive in-service courses in career education and in the teaching of elementary reading. They can also request and receive specialized reference information via satellite.

(2) In the Rocky Mountain region, junior high students are receiving a course in career education, and adults are able to view some evening programs on topics of interest to them. Also, teachers in that area, instead of having to order videotaped materials for their classes months in advance, can order materials on a large number of subjects from a video tape collection in Denver and receive the materials within days via satellite.

(3) In Alaska, people who live in villages that can be reached only by airplane, and then only when the weather is good, have a chance to learn about other people and cultures in their state. They receive several series of educational programs in village schools and have a PBS link with the contiguous 48 states.

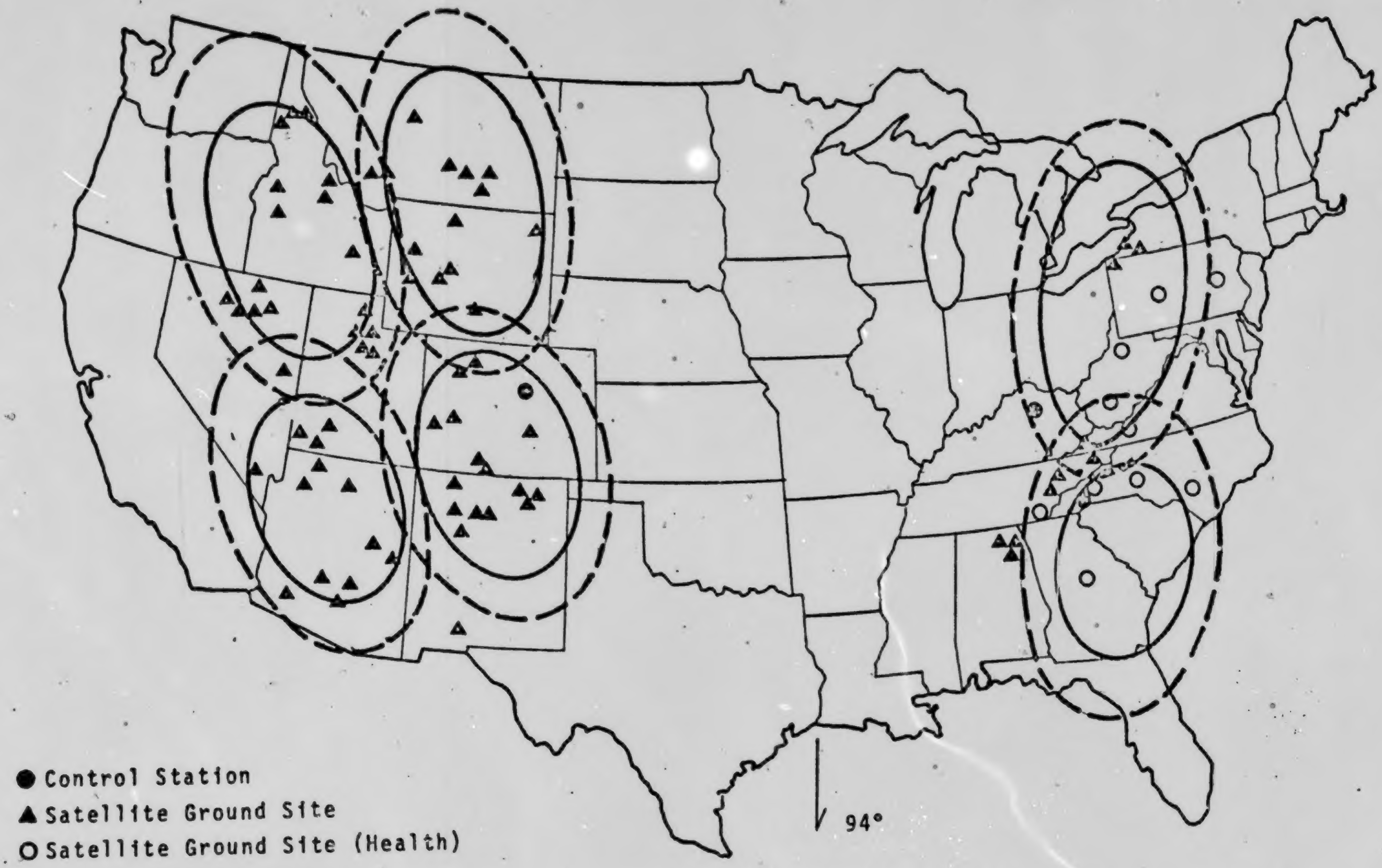
(4) In the states of Alaska and Washington and in the Appalachia regions, concurrent demonstrations in expanded health communications are also being conducted. In Alaska, the examining rooms in two small clinics at Fort Yukon (population 630) and Galena (population 425) have been equipped with comprehensive terminal facilities for communicating with viewing physicians at the Public Health Service Hospital at Tanana, Alaska, which also has a comprehensive terminal. In addition, the University of Alaska at Fairbanks is linked with the University of Washington at Seattle, which is in turn linked with medical facilities at Omak, Washington. In the Appalachia region, ten VA hospitals are participating in the VA program for exchange of medical information.

ATS Spacecraft and Ground Stations

In geosynchronous orbit over the Galápagos Islands at 94° West Longitude, the ATS-6 spacecraft is the most complex and powerful communications system developed in the 15-year history of communications satellites. It is capable of generating multiple frequencies, diverse beam paths, and high power levels. The heart of the system comprises a multi-frequency transponder, a redundant transmitting/receiving device containing six receivers and nine transmitters capable of operating on about 20 frequencies ranging from 136 MHz to 6 GHz. All the transmitters and receiving units are cross-strapped, making the system analogous to a switchboard. For the health education telecommunications (HET) experiments, ATS-6 relays two separate color TV signals, each accompanied by four voice channels. The ATS-1 and ATS-3 spacecrafts are used for two-way voice and data transmissions in support of ATS-6 during these experiments. Each of the two ATS-6 transmitters bounces a signal off the parabolic reflector to produce a Southern beam and a Northern beam, forming a gigantic "footprint" on the earth's surface. Because of the earth's curvature, each of the footprints varies in size at increasing latitudes. The footprints are approximately 300 miles

ATS-6 HET* FOOTPRINTS IN ROCKY MOUNTAIN AND APPALACHIAN REGIONS

(SATELLITE AT 94° WEST LONGITUDE)

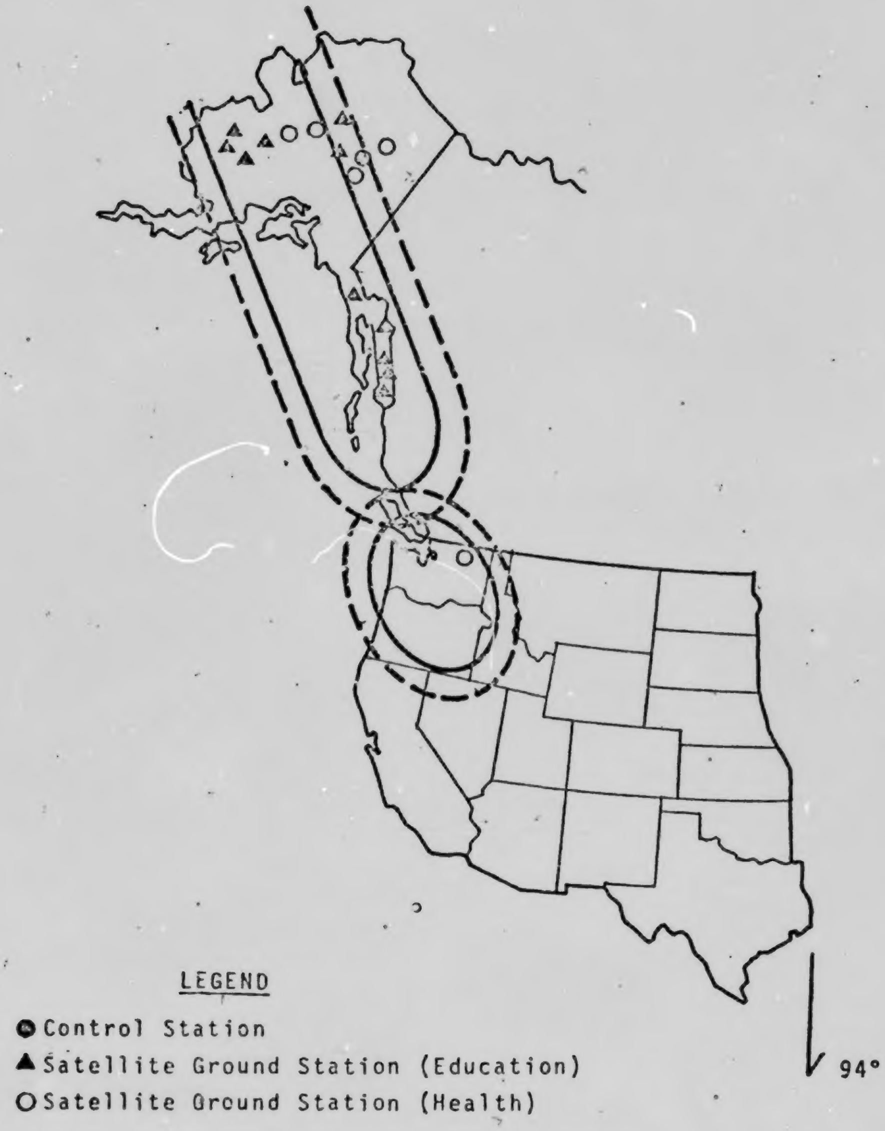

● Control Station
▲ Satellite Ground Site
○ Satellite Ground Site (Health)
94°

*HEALTH-EDUCATION TELECOMMUNICATIONS EXPERIMENT

Figure VI-F

ATS-6 HET* FOOTPRINTS IN ALASKA/NORTHWEST

(SATELLITE AT 94° WEST LONGITUDE)


LEGEND
● Control Station
▲ Satellite Ground Station (Education)
○ Satellite Ground Station (Health)
94°

*HEALTH-EDUCATION TELECOMMUNICATIONS EXPERIMENT

Figure VI-G

in diameter at the equator; about 300 miles wide by 500 miles long at about 35° North Latitude; about 300 miles wide by 600 miles long at about 43° North Latitude; and about 300 miles wide by 900 miles long at about 58° North Latitude.

On command from the ATS Operations Control Center at Goddard Space Center, Maryland, and transmitted from the ATS ground stations at Rosman, North Carolina, or Mojave, California, the spacecraft can be repointed, and the transmission "footprint" shifted from one axis to another. About five minutes of maneuvering are required to change the viewing axis from the Western to the Eastern footprint for the Rocky Mountains region, and about 15 minutes to shift the axis from the Rocky Mountains to Appalachia or Alaska. Network discipline for all the HET transmissions is being maintained through a Network Control Center at Denver.

The ground terminals used in the HET experiments represent the design of Denver-based Satellite Technology Demonstration (STD) engineers, who have developed antenna/receivers costing about $4000 apiece, the lowest priced equipment of this type ever produced for use in the United States, although when the ATS-6 moves to India this year ground terminals costing only $600 apiece will be used. "Intensive Terminals" (IT's), having a two-way broadcasting capability, and "Receive-Only Terminals" (ROT's), which can receive the satellite signals but not communicate back through the satellite, are being used. Sixteen sites in 13 states in the Appalachian Mountain Region are participating in the education experiment, and ten VA hospitals in the Appalachian Region are participating in the health experiment. Nineteen sites in Alaska and two in the Pacific Northwest are also participating in the educational and health programs. Sixty-nine locations in eight Western states have terminals installed for the Rocky Mountain experiments; of these installations, 24, all at schools, are IT's. Forty-five are ROT's, 32 of which are located at rural schools and 13 at public television stations.

Education Experiments

The Appalachia Project has been developed by the Appalachia Regional Commission (ARC). The ARC, selected Regional Education Service Agencies (RESA's), and the University of Kentucky are participating in the satellite project. During the 1974-1975 school year, junior high and senior high teachers have been offered, by satellite, in-service training courses in career education. The courses consist of live seminars and are beamed at 15 RESA's after school hours. The 15 RESA's have been divided into five groups of three each. In each group, the main RESA has an IT terminal. The other two are connected to the main RESA by land lines, so that questions and comments can be relayed from receive-only terminals through the main RESA, and thence via ATS-3 satellite to the facilities at the University of Kentucky. The programs have been requested by, and are being made available to, statewide educational television stations, the other RESA's, and 150 county school districts after the project ends. Thus, at least 10,000 to 15,000 other teachers will ultimately have access to the programs.

The Rocky Mountain Project, labeled the Satellite Technology Demonstration (STD), focuses on junior high students as its primary audience. Since September, 1974, about 4,900 students in 56 remote, rural communities throughout Colorado, New Mexico, Arizona, Utah, Nevada, Idaho, Montana, and Wyoming have been receiving programs in career education. Programming is broadcast from Denver to the schools for 35 minutes a day through the satellite. The programming is duplicated for each of the footprints. As many as 20,000 more students also receive the programs through the public television stations of the region. STD terminals are installed at 68 communities: 56 in the rural schools and 12 in PBS stations. Twenty-four of the rural schools, three per state, have been selected as IT sites. During a segment of the live broadcasting, these sites have two-way capabilities for audio communication with each other and with the Denver station through the ATS-3 satellite. The other 32 rural schools and 12 PBS stations have ROT's. Teachers at the 56 rural schools receive catalogs from which they can request some 300 videotaped programs on various subjects, such as history, social studies, or mathematics. The videotaped material is then transmitted from Denver through the ATS-6 satellite to a video tape recorder at the school. The STD also originates adult, community-oriented programming to the 56 rural schools one evening every third week, focusing on subjects of concern discovered in community surveys, such as aging, health care, alcoholism, and drugs. In addition, prior to the start of the 1974-1975 school year programming was provided for teachers, counselors, administrators, and other school personnel involved in career education at the 56 sites.

The Alaskan satellite project is broadcasting to 18 communities. Two major areas of activity are involved: instructional programming and public broadcasting. All 18 sites have two-way audio connection through the ATS-1 satellite. This connection is used in teacher training as well as in education of the students, especially in the basic oral language development programs. The other major activity of the Alaska project, public broadcasting, is designed for the general population. The satellite provides the link between Alaska and the PBS and national public radio systems in other states.

Health Experiments

Since 1971, DHEW has supported an experiment to improve the health care of native Alaskans by using the ATS-1 satellite for voice communications between Public Health Service physicians and health aides in remote villages. The Tanana Service Unit, an area about the size of Texas in central Alaska, is the site of the experiment. Earth stations with satellite communication capability have been installed in 26 villages and are used to relay voice consultations between physicians and aides. This project has generally improved the quality of the health care in the area involved.

The experiment in telemedicine described above, as well as earlier in this chapter, is being conducted at five sites in Alaska. Examining rooms in the small clinics at Fort Yukon and Galena have been equipped with "Comprehensive Terminals" (CT's) for sending and receiving video, audio, physiological information, and medical record data. The medics and health aides present patients at these clinics to physicians viewing from the Public Health Hospital at Tanana. Consultation with specialists is possible between Tanana and Fairbanks (both having CT's) and with the Alaska Native Health Center at Anchorage (having an IT).

The health education experiment in the Northwest is designed to test the feasibility of providing instruction to medical students via satellite so that aspiring physicians in states without medical schools will have the opportunity to study medicine on an equal footing with students in other states. Instruction in the basic sciences involves the faculty at the University of Washington in Seattle, and students and faculty at the University of Alaska in Fairbanks. Full two-way voice and video interaction are provided for classes in basic sciences (chemistry, biology, etc.), administrative conferencing, counseling, computer-assisted instruction, and evaluation of student performance. Lectures, demonstration, and classroom experiments can originate from both sites, resulting in a lively interchange between students and faculty at both ends. The part of the experiment dealing with clinical medicine involves third and fourth year medical students studying under clinicians at Omak, in central Washington. The students can present patients (by video and voice transmission) to the medical faculty at the University of Washington in Seattle. Faculty are able to respond to students only by voice. The students are required to give both formal and spontaneous presentation of the patients.

Ten VA hospitals within the Appalachia footprint of the ATS-6 are participating in the VA program for exchange of medical information as part of the HET experiment. The hospitals are located in Altoona and Wilkes-Barre, Pennsylvania; Beckley and Clarksburg, West Virginia; Fayetteville, Oteen, and Salisbury, North Carolina; Dublin, Georgia; and Mountain Home, Tennessee. The aim of the experiment is to bring these hospitals into direct communication with urban medical teaching centers. Telecasts of about two and one-half hours weekly are scheduled during the period that the ATS-6 satellite is used in the current HET experiment. More than 50 topics, covering broad areas of interest, are being presented, and both black and white and color are used for slow-scan or compressed video transmissions. Slow-scan television in color has never been adequately tested before in this type of two-way teleconsultation setting. The technique provides still pictures which are displayed on a TV monitor after being sent as an electrical signal over telephone lines. Depending on the complexity of the matter, a half-minute or more is required to transmit and display images via slow-scan. To eliminate the need for audiences or consultants to wait in front of TV screens, the slow-scan visuals are transmitted prior to each of the teleconsultation broadcasts and stored on discs.

Satellite Costs

The ATS-6 satellite, the primary vehicle for the current HET experiments, costs about $180 million for the spacecraft and about $25 million for the launch vehicle and services. The 116 ground terminals cost about $464,000 (approximately $4,000 each). These experiments are funded by the National Institute of Education and the U. S. Department of Health, Education, and Welfare.

COMPUTER NETWORKS

The TUCC

The Triangle Universities Computation Center (TUCC) was established in 1965 as a non-profit corporation by three universities in North Carolina: Duke University at Durham, the University of North Carolina at Chapel Hill, and North Carolina State University at Raleigh. Duke University is privately endowed; the other two universities are state-supported. Their combined facilities include two medical schools and two engineering schools, and together they have 30,000 undergraduate students, 10,000 graduate students, and 3,300 faculty members. The primary motivation for establishing TUCC was economic: to give each of the institutions access to more computing power at lower cost than it could provide individually.

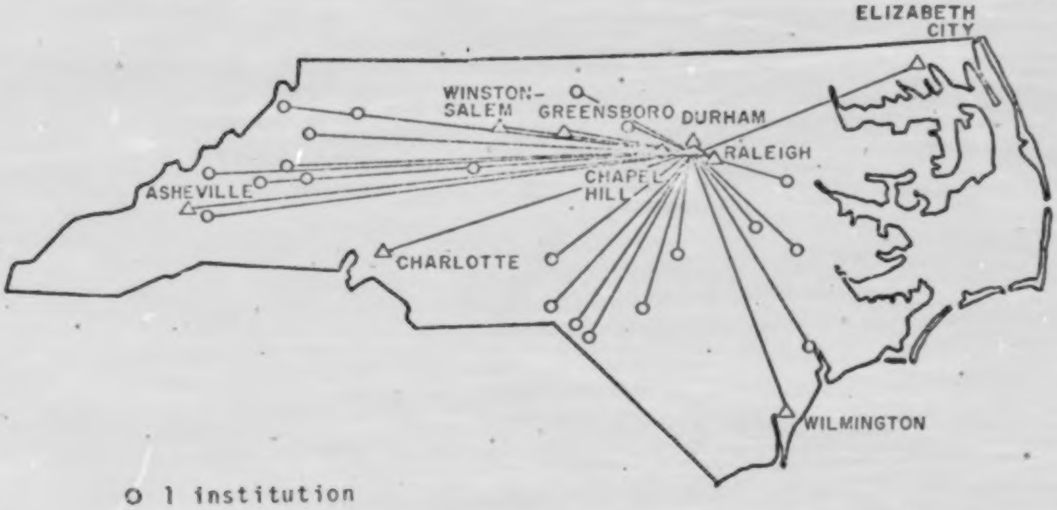
TUCC headquarters are in the North Carolina Board of Science and Technology's Research Triangle Park Building, situated in one of the nation's most successful research parks. Set on a wooded tract of 5,200 acres in the small geographic triangle formed by the three universities, the Research Triangle Park contains forty buildings housing the research and development facilities of nineteen separate national and international corporations, government agencies, and other institutions. The North Carolina Board of Higher Education has established an organization which is known as the North Carolina Educational Computing Service (NCECS), and which is the successor of the North Carolina Computer Orientation Project initiated in 1966. NCECS participates in TUCC and provides computer service to public and private educational institutions in North Carolina other than the three founding universities. Presently 40 public and private universities, junior colleges, and technical institutes, plus one high school system, are thus served.

NCECS is located with TUCC in the same building in the Research Triangle Park. It serves as a statewide campus computation center for users, providing technical assistance, information, and related services. The curriculum work and the programs of the NCECS have aroused interest in computing in institutions and departments where there was previously no interest at all.

Network description. TUCC is essentially a centralized homogeneous network, comprising a two megabyte telecommunications-oriented central service node located at the Research Triangle Park and using OS/360-MVT/HASP (IBM 370/165); three primary job source nodes (an IBM 360/75 at Chapel Hill, and IBM 360/40's at North Carolina State and Duke); 23 secondary job source nodes (leased line Data 100's, UCC 1200's, IBM 1130's, IBM 2780's, and leased- and dial-line IBM 2770's); and about 125 tertiary job source nodes (64 dial or leased lines for Teletype 33 ASR's, IBM 1050's, IBM 2741's, UCC 1035's, etc.). All service node computers in the network are homogeneous with the central service node, and, although they provide local computational service in addition to teleprocessing service, none currently provides non-local network computational service. The three campus computer centers are completely autonomous. (See Figure VI-H.)

NORTH CAROLINA COMPUTER NETWORK

THE TRIANGLE UNIVERSITIES COMPUTATION CENTER (TUCC) NETWORK


ELIZABETH CITY
WINSTON-SALEM
GREENSBORO
DURHAM
RALEIGH
CHAPEL HILL
ASHEVILLE
CHARLOTTE
WILMINGTON

○ 1 institution

△ 2-12 institutions

Figure VI-H

Programming. TUCC supports educational research, and, to a lesser but increasing extent, administrative computing requirements at the three universities, as well as at 50 smaller institutions in the state and several research laboratories, by means of multispeed communications and computer terminal facilities. The central service node (IBM 370/165) has processed up to 6,100 jobs per day without saturation. This figure includes about 3,100 autobatch jobs, 2,500 other batch jobs, and 450 interactive sessions. Of the autobatch jobs, 94 percent can be processed with less than 30 minutes delay, and 100 percent with less than three hours delay. Of all the jobs, 77 percent can be processed with less than 30 minutes delay, and 99 percent with less than five hours delay. At the present time, about 8,000 different individual users are being served directly. Services to the TUCC user community include both remote job entry (RJE) and interactive processing; the interactive services involve programming systems employing the BASIC/PL-1 and APL languages. A large number of compilers are available through RJE, including FORTRAN IV, PL/1, COBOL, ALGOL, PL/C, WATFIV, and WATBOL. These language facilities, coupled with an extensive library of application programs, provide the TUCC user community with a dynamic information-processing system supporting a wide variety of academic computing needs.

Organization. TUCC is a wholesaler of computing service; this service consists essentially of computing cycles, an effective operating system, programming languages, some application packages, a documentation service, and management. The TUCC wholesale service does not include debugging and contract programming, which are provided by the campus computation centers and NCECS, acting as the retailers for the TUCC network. This wholesaler-retailer concept can be seen in both the financial and the service relationships. Each biennium, the founding universities negotiate with each other and with TUCC to establish a minimum financial commitment from each to the net costs budgeted for TUCC. Then, on an annual basis, the founding universities and TUCC negotiate to establish the TUCC machine configuration, each university's computing resource share, and the cost to each university. Presently, each of the three founding universities is allocated a 25 percent share, with the remaining 25 percent available for NCECS, TUCC systems development, and other users. This resource allocation is administered by a scheduling algorithm which ensures that each group of users has access to its daily share of TUCC computing resources. The algorithm provides an effective trade-off between computing time and turn-around time for each category; that is, at any given time the group with the least use that day will have job selection preference. The scheduling algorithm also allows the founding universities and NCECS to define and administer quite flexible, independent priority schemes. Thus, the algorithm effectively defines independent submachines for the retailers, providing them with the same kind of assurance that they can take care of their users' needs as would be the case with totally independent facilities.

Funding. In 1972 the Park had 8,500 employees, a payroll of $100 million, and an investment in facilities of $400 million. The present budget of the TUCC is about $1.5 million. The financial advantages of the system deserve further comment. As a part of the planning leading to installation of the IBM 370/165, one of the universities concluded that for it to provide all computing services on campus would cost about $19,000 more per month in hardware and personnel than would continued participation in TUCC. This represented a 40 percent increase over present expenses for the same services, and there are other significant advantages to use of the TUCC system. First, there is the sharing of a wide variety of application programs. Once a program is developed at one institution, it can be used anywhere in the network with no difficulty. For proprietary programs, usually only one fee need be paid. A sophisticated TUCC documentation system sustains this activity. Second, there has been a significant impact on the ability of the universities to attract faculty members who need large-scale computing for their research and teaching, and several TUCC staff members have adjunct appointments with the university computer sciences departments. The third major advantage is the ability to provide highly competent systems programmers and systems managers for the center.

The ARPA

The Advanced Research Project Agency of the Department of the Army has conducted research since December, 1969 on communications technology for computer networking through the ARPA national network. The primary purpose of the network is resource sharing between individual users, most of whom utilize different makes or models of computer. In this system, one computer is able to "talk" to another computer through the use of two major types of equipment. The first, called an Interface Message Processor (IMP), takes the output of the computer and converts it to blocks of information that are formatted with a standard header and message addressing system. In the reverse process, involving inputs from the IMP to the computer, a conversion is made from the common system format to the manufacturer's computer format. The second device is for use with individual terminals which can transmit or receive information. It is called a Terminal Interface Processor (TIP), and converts terminal output into ARPA system transmission in block form. The reverse process is also possible here. While the above description is vastly oversimplified, the reasons for citing the ARPA network as an important one within the context of this study are that:

(1) Successful computer-to-computer communications, involving computers of different makes, models, and data speeds, are carried out automatically and at high data rates through transmission of information on an addressee basis.

(2) Resource sharing is very practical, and, if desired, can be used to transmit computer-based instructional programs from one institution to another in a highly efficient manner.

(3) Because of the block form of transmission, system load leveling is managed efficiently.

A map of the ARPA network is presented as Figure VI-I. A detailed listing of all of the computer models used in the system is given in Figure VI-J; this system comprises over fifty mode computers called IMPS, as previously described. Each IMP is connected to a "HOST" computer. The specific technique of moving blocks of information (messages) has been given the name "packet switching," and packet transmission between the IMPS on the network is at the rate of 50 kilobits per second. The system maintains a very rigid modus operandi involving discrete addressing procedures, transmission actuating codes, error control codes and acknowledgement codes. Technically, the ARPA network is a ring network, functioning through the input, circulation, and removal of information.

TETHERED COMMUNICATIONS

All telecommunications broadcast facilities are limited by the total geographic area covered by the signal broadcast--generally line of sight in the higher frequencies. As the state of the art of telecommunications has advanced, various technologies have been developed to extend coverage. It has long been recognized that, within certain bounds, signal coverage can be extended by taking advantage of the phenomenon known as diffraction, using frequencies in the lower frequency spectrum; by increasing the transmit power; and by increasing the height of the transmit antenna. However, all three methods have practical limitations, including the use of an antenna some 20,300 miles in space (a satellite in synchronous orbit).

As has been indicated already, the prohibitive cost of satellite communications limits their use to special purposes. Further, terrestrial signal towers are limited to heights of about 2,000 feet because of the sheer weight and stresses imposed on larger structures. A reasonable compromise between satellite and terrestial systems may be possible, however, through the use of aerostats (balloons) as a stable platform for a communications package, which really began in 1967. As the result of a combination of advances in the fabric design of aerostats and the development of complex computer programs capable of predicting their aerodynamic behavior, they were considered at this time as candidates for elevated platforms from which extended line-of-sight was possible. The type of aerostat first used to determine the feasibility of this concept is very similar to the barrage balloons used over England during World War II.

ARPA NETWORK, GEOGRAPHIC MAP

APRIL 1975

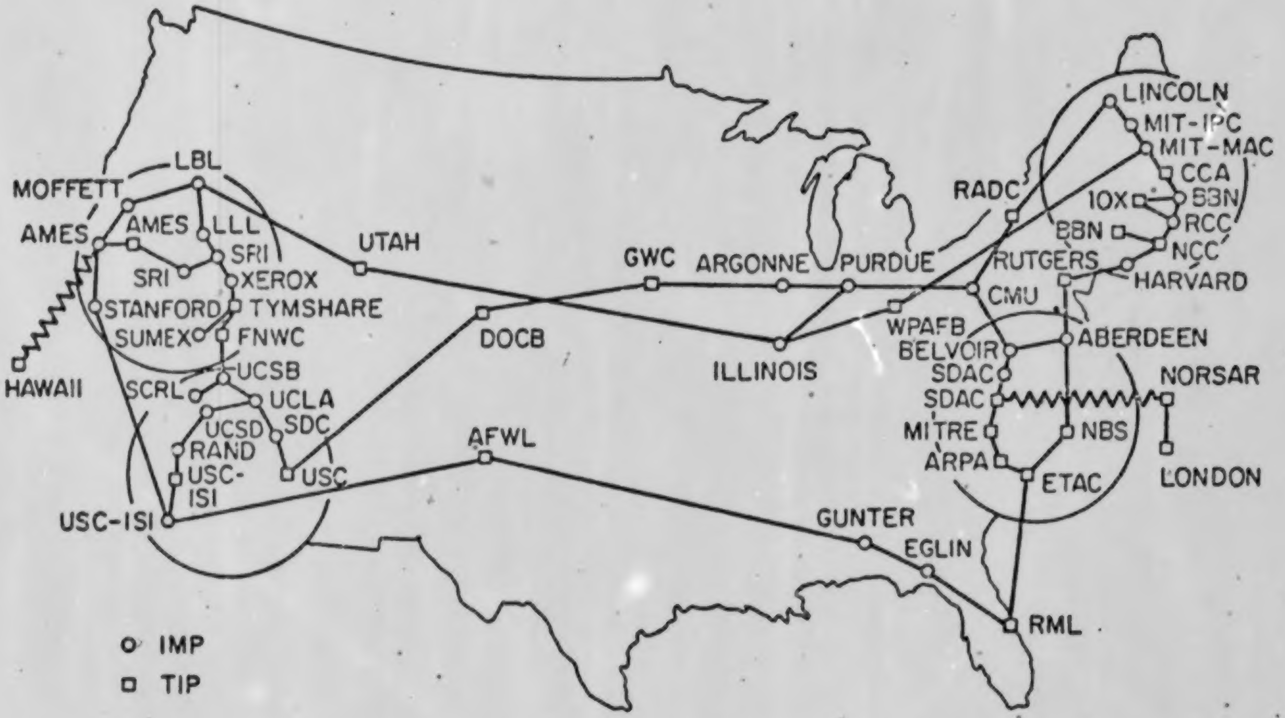

LINCOLN
MIT-IPC
MIT-MAC
CCA
10X
BBN
BBN
RCC
NCC
HARVARD
RADC
RUTGERS
CMU
MOFFETT
LBL
AMES
AMES
LLL
SRI
SRI
XEROX
STANFORD
TYMSHARE
SUMEX
FNWC
HAWAII
UCSB
SCRL
UCLA
UCSD
SDC
RAND
USC-
ISI
USC
USC-ISI
UTAH
GWC
ARGONNE
PURDUE
DOCB
ILLINOIS
WPAFB
BELVOIR
ABERDEEN
SDAC
SDAC
NORSAR
MITRE
NBS
ARPA
ETAC
LONDON
AFWL
GUNTER
EGLIN
RML
IMP
TIP

Figure VI-I

ARPA NETWORK, LOGICAL MAP, APRIL 1975

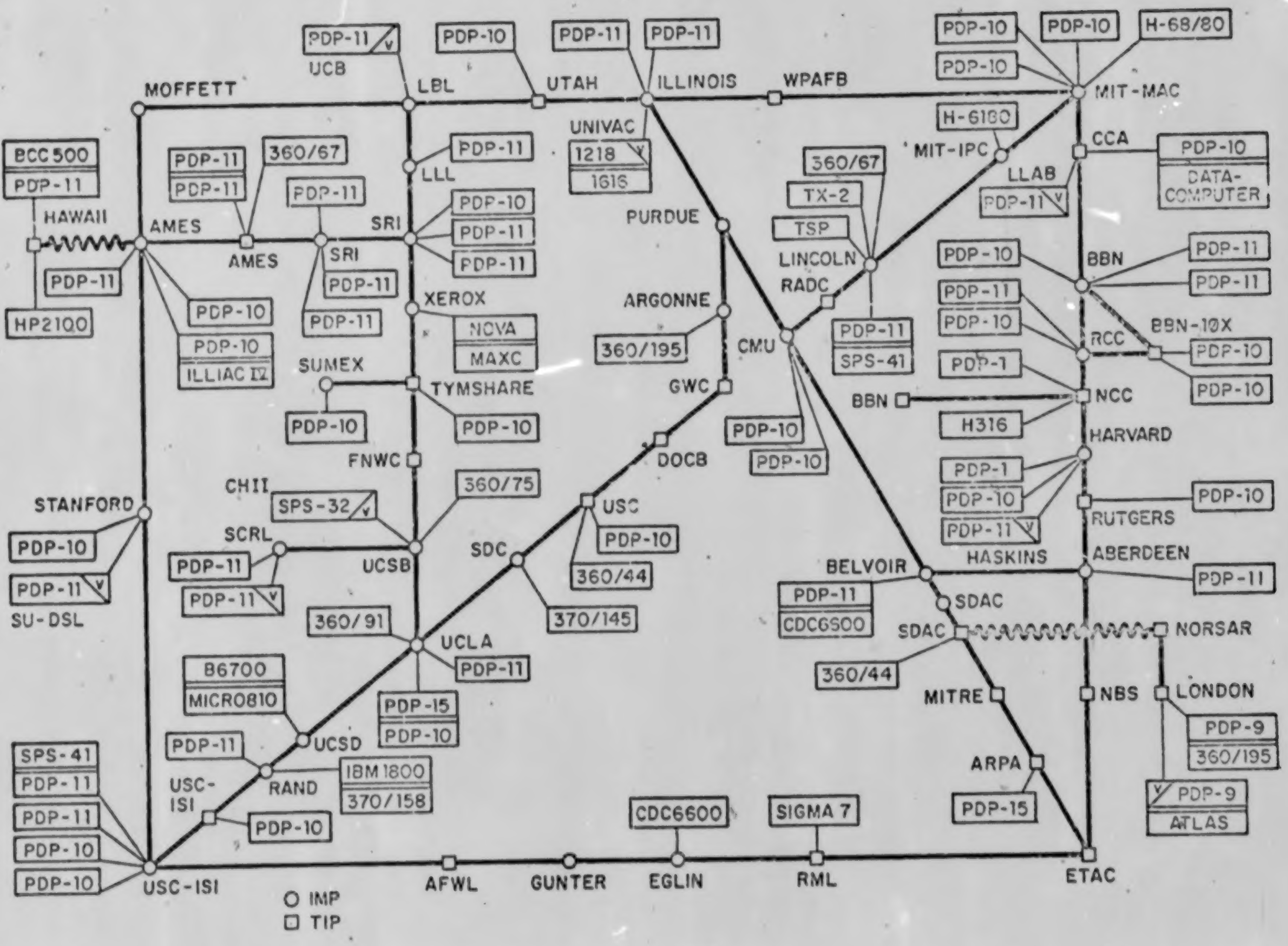

MOFFETT
UCB
PDP-11
LBL
PDP-10
UTAH
ILLINOIS
PDP-11
PDP-11
WPAFB
MIT-MAC
PDP-10
PDP-10
PDP-10
H-68/80
UNIVAC
1218
1616
H-6180
MIT-IPC
CCA
PDP-10
DATA-COMPUTER
LLAB
PDP-11
BCC500
PDP-11
HAWAII
HP2100
AMES
AMES
360/67
SRI
SRI
LLL
XEROX
NOVA
MAXC
SUMEX
TYMSHARE
FNWC
PURDUE
ARGONNE
360/195
GWC
CMU
LINCOLN
360/67
TX-2
TSP
RADC
SPS-41
BBN
RCC
BBN-10X
NCC
BBN
H316
PDP-1
HARVARD
RUTGERS
ABERDEEN
HASKINS
BELVOIR
CDC6600
SDAC
SDAC
360/44
NORSAR
NBS
LONDON
PDP-9
360/195
ATLAS
MITRE
ARPA
PDP-15
STANFORD
SU-DSL
CHII
SPS-32
360/75
SCRL
UCSB
DOCB
USC
360/44
SDC
370/145
360/91
UCLA
B6700
MICRO810
UCSD
PDP-15
RAND
IBM 1800
370/158
USC-ISI
SPS-41
USC-ISI
AFWL
GUNTER
EGLIN
CDC6600
RML
SIGMA 7
ETAC
ILLIAC IV
○ IMP
□ TIP

Figure VI-J

Aerostat Description

Tethered communications (TCOM) are the product of the TCOM Corporation, a subsidiary of the Federal Electric Corporation. Through the suspension of solid state electronics packages from stable platforms beneath aerodynamically stable aerostats, a wide range of telecommunications services are provided at costs significantly lower than those of any other existing or planned telecommunications technology.

TCOM systems capitalize on the height advantage of all-weather tethered aerostats. Each aerostat is "flown" from a ground control station. The vehicles themselves are unmanned, and maintain their positions in the immediate vicinity of the launch site. The family of TCOM aerostats range in volume and size from 1,400 cubic meters in volume and 35 meters long (the Mark V) to 17,000 cubic meters in volume and 85 meters long (the Mark VIII). The selection of a particular aerostat for use in each TCOM system is determined by lifting requirements and operations altitude necessary for the required line-of-sight transmission coverage. (See Figure VI-K.)

While the vehicles vary greatly in size and volume, each is a true aerodynamic aerostat, constructed to withstand very severe weather conditions such as desert sun, snow, ice, high humidity, and even tempests. For example, the Mark VII is designed to operate safely at altitude in winds of 210 kph. Since most steel towers are designed to withstand winds of 160 to 190 kph, the Mark VII balloon can easily survive hurricane force winds.

The maximum operating altitude of the aerostats is a function of aerodynamic lift, helium volume at altitude, and total weight aloft. Typically, TCOM systems are operated at fixed altitudes, as required, between 10,000 and 15,000 feet; however, the main winch storage drums can hold over 20,000 feet of 1.97 cm diameter tether. Where maximum reliability is essential in 24-hour operation, each ground station is equipped with two aerostats, each complete with electronics packages; however, operation with a single aerostat can be carried out with a reliability of approximately 99 percent. In a two aerostat operation, one aerostat is always active, providing the communications services required, while the other is in a "hot" standby mode, fully configured and ready to become operational instantly upon command.

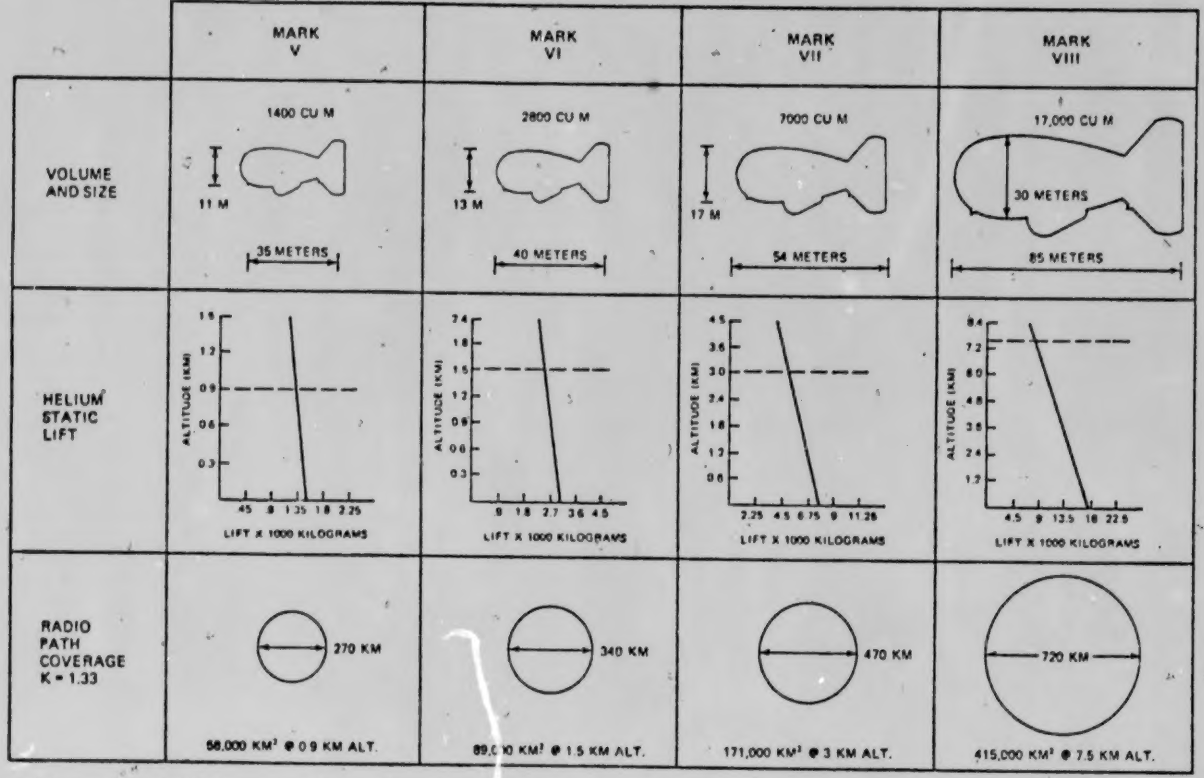
Currently, power for the airborne package, provided by two Wankel engines, is sufficient to provide 24-hour operation for about eight days. In normal operations, each aerostat is in-hauled for refueling and maintenance prior to its maximum mission time. About four hours are generally required for each refueling and routine maintenance for an aerostat. When a powered tether, now under development, becomes available, refueling will no longer be necessary. The powered tether will allow longer station times, larger communications packages, and/or higher operational altitudes.

Electronics Description

Each communications payload contains a local area transceiver section and a longline transceiver section. A single payload, suspended beneath an aerostat at 10,000 feet, provides coverage over a radial distance of 125 miles and covers a ground area close to 50,000 square miles. To approximate the TCOM coverage, about 31 conventional TV broad (moderate height antenna with average power) systems would be required. The long lines equipment permits transmission and reception of communications data between two or more aerostats, greatly extending the coverage area. Since the distances between aerostats are on the order of 250 miles, communications between two points as much as 500 miles apart can be effected. As many as five channels of wideband data could be received simultaneously from anywhere within the wide coverage area, and retransmitted to any number of ground stations and other aerostats.

Included in the electronics package is a telemetry and command system which controls and monitors all the communications equipment on board the aerostat. Vital aerostat data, including such functions as altitude, pitch, roll, and heading, are also monitored. The reliability of this system is assured through the use of redundant transmitters and receivers and an automatic switchover capability.

TCOM AEROSTATS*


MARK V
MARK VI
MARK VII
MARK VIII
VOLUME AND SIZE
1400 CU M
11 M
35 METERS
2800 CU M
13 M
40 METERS
7000 CU M
17 M
54 METERS
17,000 CU M
30 METERS
85 METERS
HELIUM STATIC LIFT
ALTITUDE (KM)
1.5
1.2
0.9
0.6
0.3
.45 .9 1.35 1.8 2.25
LIFT X 1000 KILOGRAMS
2.4
1.8
1.5
1.2
0.9
0.6
0.3
.9 1.8 2.7 3.6 4.5
4.5
3.6
3.0
2.4
1.8
1.2
0.6
2.25 4.5 6.75 9 11.25
8.4
7.2
6.0
4.8
3.6
2.4
1.2
4.5 9 13.5 18 22.5
RADIO PATH COVERAGE K = 1.33
270 KM
58,000 KM² @ 0.9 KM ALT.
340 KM
89,000 KM² @ 1.5 KM ALT.
470 KM
171,000 KM² @ 3 KM ALT.
720 KM
415,000 KM² @ 7.5 KM ALT.

*Taken from TCOM Corporation, The TCOM System: General Description; Part I: Aerostats (Rockville, Maryland: TCOM, April 1973), p. 3.

Figure VI-K

Some of the numerous capabilities of the aerostats include longline wideband telephone, television, AM and FM radio broadcast, and digital data transmission. Since the airborne package is modular in concept, any of the TCOM capabilities can be integrated into a system to fulfill present telecommunications requirements. Further, each package has a designed-in growth potential and can be easily expanded to meet growing telecommunications needs in terms of either increased capacity or expanded facilities.

TEXAS--A COMPARISON WITH ALABAMA, KENTUCKY, LOUISIANA, AND OHIO

Any comparison of the state of Texas with any other state is difficult at best, and impractical in most cases. Texas is a state of paradoxes unmatched by other states. In population, Texas ranks fourth among all the states; yet in population density it is 33rd (see Table VI-a). Many parts of the state, particularly the Panhandle and Big Bend areas, have a population density approximating one person per square mile, with fewer than fifteen persons per square mile in about 55 percent of the state. (See Figure IV-L.) By way of contrast, Alabama, Kentucky, Louisiana, and Ohio have a more even population distribution. Population density has a great impact on any regional plans for a statewide telecommunications system, and a broadcast telecommunications network would be uneconomical for approximately half of Texas when costed purely on this basis. However, in comparing a broadcast system for Texas with a broadcast system for Kentucky, there are some similarities, based largely on the rough and mountainous terrain of Kentucky which makes signal distribution a frustrating dilemma. In the flat terrain of Texas, one broadcast station could cover an area that would require as many as three or four stations in Kentucky, and this factor tends to "reduce" the size of Texas when comparing it with a mountainous state like Kentucky. However, because of the very low density of population in western Texas, the cost per individual would be astronomically high, even though the transmission characteristics are favorable. It would appear, then, that those technological solutions that are particularly suitable for the education of students in dense urban areas are not, with few exceptions, suitable either for sparsely populated or for mountainous areas. Extending this logic further, some parts of Texas may be more suited to certain technologies, such as satellites, than others, although any and all of the technologies implemented should be as compatible as possible to allow for population growth and technological advances.

As might be expected, Texas has more schools (5,964) than the other states discussed here, although Ohio, with 5,167 schools, comes closest. Total population, then, would appear to be a rough measure of the number of schools required. The annual enrollment in Texas public schools currently runs about 2,850,000, with an average daily attendance of approximately 2,500,000. An annual increase of about 4.6% per year has been observed; however, that figure could decrease to not more than 1% in 20 years. Zero population growth might become a reality by the year 2000 if current projections prove accurate, thereby stabilizing the number of new schools needed, and any changes in population patterns could be expected to impact on school construction or closure programs.

An examination of the costs of school operations in Texas compared with those in Alabama, Kentucky, Louisiana, and Ohio reveals some rather surprising facts. (See Table VI-b.) Texas, with a per capita income of $4,336, spent an average of $809 per student per year on education, or nearly 10 percent of the per capita income of the state. Alabama, Kentucky, and Ohio spent about the same percentage. Louisiana, on the other hand, with a per capita income of only $3,825, spent nearly 26 percent of this income on education. With the educational telecommunications plans presently being implemented within the state, Louisiana is expected to increase its support of education still further. Teacher salaries in Texas, again, when compared with those in Alabama, Kentucky, Louisiana, and Ohio, are generally less in relation to per capita income. Texas ranks 36th in teachers' salaries paid, and 42nd in educational expenditures on the basis of ADA (see Table VI-a). Certainly, quality education is directly related to the competence of the teachers hired. Competent teachers are attracted by high salaries; therefore, any proposals to improve the quality of Texas schools should include increases in the wages paid to teachers and administrators.

EDUCATIONAL STATISTICS OF THE TEN MOST POPULOUS STATES

(in order of population, 1972)

STATE	POPULATION 1972		POPULATION DENSITY (per sq. mile)		POPULATION* PROJECTION--1990		SCHOOL DISTRICTS	
	Number	Rank	Number	Rank	Number	Rank	Number	Rank
California	20,601,000	1	132	14	30,528,000	1	1,046	2
New York	18,265,000	2	382	6	22,897,000	2	766	4
Pennsylvania	11,902,000	3	265	8	13,360,000	6	512	10
Texas	11,794,000	4	45	33	15,474,000	3	1,104	1
Illinois	11,236,000	5	202	10	14,477,000	4	1,024	3
Ohio	10,731,000	6	262	9	13,619,000	5	617	6
Michigan	9,044,000	7	159	11	12,051,000	7	543	9
Florida	7,678,000	8	142	13	10,241,000	8	89	36
New Jersey	7,361,000	9	979	1	10,152,000	9	560	8
Massachusetts	5,818,000	10	743	3	7,354,000	10	285	19

STATE	VOCATIONAL ENROLLMENT		ANNUAL PER CAPITA INCOME		ANNUAL AVERAGE TEACHER'S SALARY--1974		ANNUAL EDUCATIONAL EXPENDITURES PER ADA	
	Number	Rank	Amount	Rank	Amount	Rank	Amount	Rank
California	1,234	2	$5,438	9	$12,850	2	$1,170	13
New York	920	3	5,663	4	12,800	3	1,809	1
Pennsylvania	327	10	4,894	19	10,900	16	1,247	7
Texas	648	4	4,336	33	8,967	36	809	42
Illinois	1,380	1	5,753	3	11,791	7	1,228	9
Ohio	447	7	5,012	15	10,300	20	1,009	24
Michigan	343	13	5,439	8	12,545	4	1,271	5
Florida	605	5	4,647	28	10,430	19	1,041	21
New Jersey	342	12	5,759	2	11,900	6	1,294	6
Massachusetts	164	21	5,233	12	10,995	14	1,136	16

*Projections include interstate migrations.

Table VI-a

1974 STATISTICS	Texas	Alabama	Kentucky	Louisiana	Ohio
Length of School Term (days) (U.S., 179.2 days)	179.8	175.8	174.4	179.6	180.0
Number of Public Elementary Teachers	71,922	17,472	19,600	21,650	54,915
Number of Public Secondary Teachers	63,780	17,823	12,100	18,650	49,277
Average Salary of Public Elementary Teachers	$8,867	$9,171	$8,020	$8,750	$10,030
Average Salary of Public Secondary Teachers	$9,068	$9,354	$8,575	$9,235	$10,600
Public School Expenditures (millions)	$2,548	$575	$544	$846	$2,457
Average Expenditure/ Pupil in ADA (dollars)	$809	$716	$727	$978	$1,009
Cost/Student/Year (dollars)	$797.30*	$716.00	$727.00	$978.00	$1,009.00
Cost/Student/Day (dollars)	$4.43	$4.07	$4.17	$5.45	$5.61
Cost/Student/Hour (dollars)	$.74	$.68	$.69	$.91	$.93

*Figures provided by TEA for school year 1973-1974.

Table VI-b

SUMMARY AND IMPLICATIONS

Centralized supervision of educational telecommunications facilities varies greatly among states. To illustrate: 12 states have no statewide control or supervision of statewide telecommunications for education; Arkansas with its Department of General Services, Montana with its Supervisor of Public Instruction, and Wyoming with its Educational TV Commission have one-of-a-kind supervisory units; six states limit control to the university level; eight states have advisory or coordinating commissions; and 20 states have "take charge" commissions that direct and supervise educational telecommunications on a statewide basis. Alabama and Kentucky, which have "take charge" commissions, provide examples of direct statewide control of educational telecommunications. Louisiana and Ohio, with their "coordinating" commissions, exemplify the use of an "advisory" body for statewide educational telecommunications. As can be seen from the statistics cited above, the most popular form of commission is the "take charge" commission.

As all states which responded to our request for information and which had a statewide telecommunications system were using television as the primary educational medium, this discussion focuses on TV, although it does include the use of satellites as a means of signal delivery. Initial discussions also determined the need for inclusion of data on at least one computer network; since no state provided written information on a computer system, the North Carolina Computer Network was selected on the basis of available literature as being typical of a computer network used for educational purposes. Our studies showed

POPULATION DENSITY BY COUNTIES

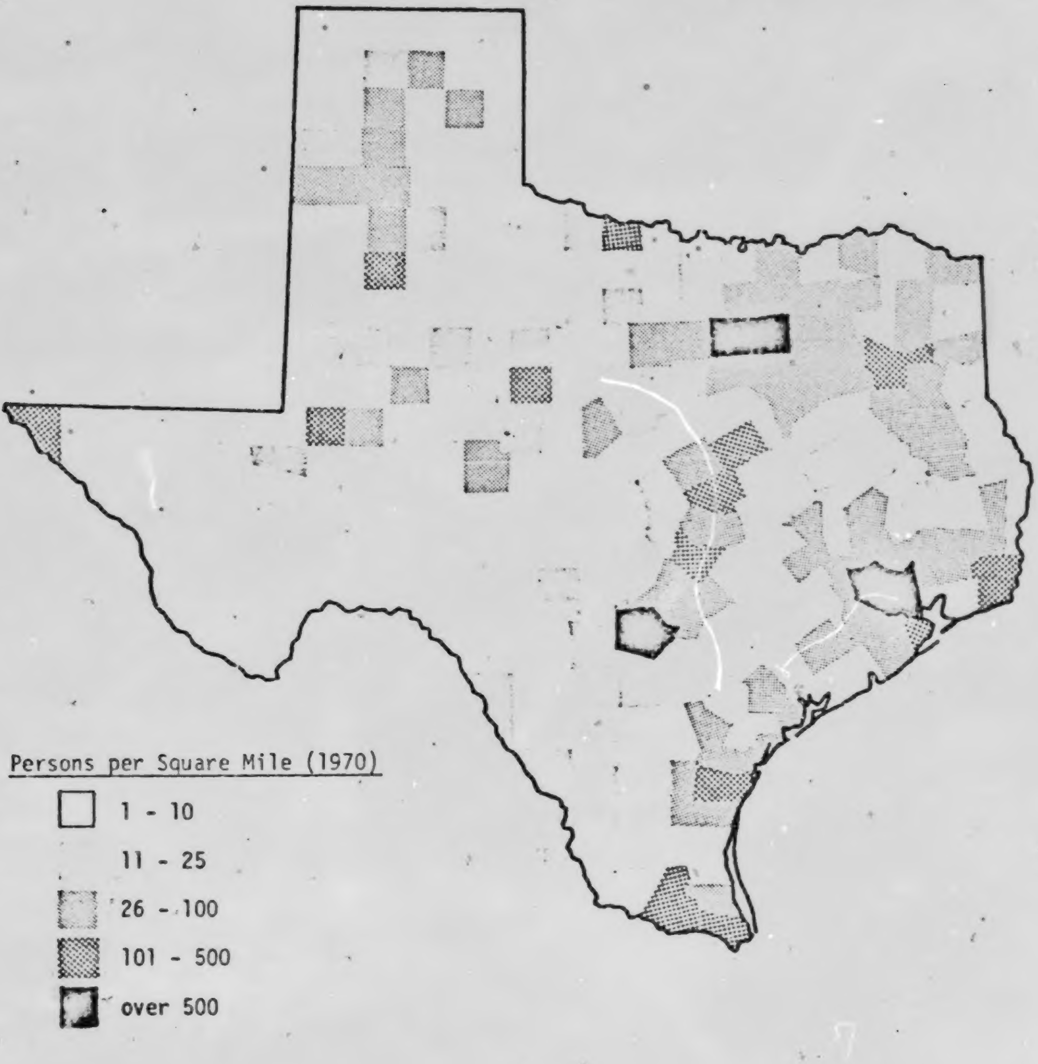

Persons per Square Mile (1970)
1 - 10
11 - 25
26 - 100
101 - 500
over 500

Figure VI-L

that computers are a useful tool for teaching, particularly in grades 5-12, and also for purposes of administration and management. The diversity of computers makes them particularly adaptable to an educational telecommunications system, and they should be considered for inclusion in any statewide network. We also investigated the possible utility of tethered communications, realizing that while the methodology is not used in this country, it is used for education in some other countries. However, the high personnel requirements and subsequent high costs for the operation of aerostats, coupled with the sparsity of population in many parts of Texas and the frequent occurrence of tornadoes and windstorms throughout the state, mitigate against their use here in a statewide educational system.

Television, as a medium, has found great favor with all states. Early TV systems were all black and white, but there now appears to be a concerted effort on the part of all the states examined to install or to switch to full color as rapidly as possible. Robert Dod, General Manager of the Alabama Educational Television Network, states that "we must convert our TV cameras to color as rapidly as possible so as to remain competitive with the commercial TV audiences." Our examination of the use of satellites as a delivery system found such a system to have limited application to Texas rural areas. It would appear that the future of satellites in educational telecommunications lies more in a national educational networking plan and in providing a means of getting programming to isolated and mountainous areas. Color TV has great potential, and would be desirable to include in any projected Texas educational telecommunications system.

All states examined include TV studios in their statewide networks. Of the two coordinating commission states of Ohio and Louisiana, each has only one network studio that serves to provide the total educational telecommunications programming for the state. Other stations in the networks have TV studios, but these are all used for local programming and are all privately owned. Alabama and Kentucky, on the other hand, give ample demonstration of the greater diversity of the "take charge" commission concept in that both provide the funds for network studios, located on each of the state university campuses, that serve three audiences: the campus, the local area, and the network. Additionally, Alabama and Kentucky have TV Network Centers that assure proper distribution of all network programs.

Alabama has an innovative contractual arrangement with three of the state ITFS systems which calls for them to provide studio facilities for the network. In return, Alabama provides network programs to the ITFS systems on a time-delayed basis. Alabama also has an unusual but innovative plan for the use of TV teachers. The state has no full-time TV teachers, but rather a "stable" of teachers qualified to teach on TV. These teachers, located around the state, are called upon when needed. They return to the classroom when their TV teaching services are no longer required. Alabama's use of TV studios, contractual arrangements with the ITFS systems, and use of TV teachers all have merit, and might be considered for adaptation to a Texas network.

Network programming is more easily managed and controlled in Alabama and Kentucky, since it is centrally managed. For example, in Alabama, the final responsibility for making program decisions rests with one person. In Ohio, this responsibility is divided among programming groups at each of the 12 stations, who make the decisions as to how the programming should be scheduled. The Ohio Network Operations Center has little voice in programming decisions, and knows only after the decisions have already been made what programs will be shown and at what time. The Ohio procedure is not recommended; the Kentucky and Alabama methods of programming, on the other hand, have merit and should be considered.

No statewide educational telecommunications network can survive without the support and backing of the teachers and administrators using the system. This is the one area that appears to be weakest in all the states. Only Kentucky offers even an orientation program for students planning to be teachers, and this program is only 2 to 3 hours in toto. Any state that sets out to develop a comprehensive system for educational telecommunications should also develop an extensive program designed to give teachers an understanding of and appreciation for the more sophisticated technological systems integrated into the overall system. The teachers of tomorrow will, of necessity, need to be knowledgeable in more than a basic skill such as English or mathematics; they must also understand the telecommunications equipment and techniques used in conjunction with their teaching, since they probably will not use equipment or facilities of which they are not knowledgeable or with which they feel uncomfortable.

In summary, and on the basis of examination of the statewide systems of five states, it is suggested that any proposed statewide telecommunications network should be managed by a "take charge" type of commission; that such a network should include television with full color equipment; that TV studios should be located at state universities and augmented by ITFS studios where necessary; that a computer network should be super-imposed over the ETV network, with large capacity computers installed at four or five central locations and remote terminals tied into the computers for classroom instruction and administrative record-keeping; that teachers capable of teaching on TV should be cataloged and assigned geographically for use as necessary; and that an extensive education program designed to train teachers in the use of the network should be implemented in the curriculum of all teacher colleges and universities.

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Software VII

PRÉCIS

One of the greatest limitations on the full and successful use of educational technology is the low availability and/or high cost of software (courseware, in the case of computers). This problem warrants full examination, which this chapter provides.

It opens with some definitions and explanations of terminology. A brief section which follows gives the current states of educational software: who produces it, where, and when; what kinds are produced; who uses it; and how much is spent on it.

A section on computers explains their educational uses and the software problems involved. This is followed by another section explaining the various facets of software problems: copyright; standardization; FCC regulations; textbook adoption programs; consumable materials; personnel; quality, validation, and transferability; distribution requirements; and evaluation and selection. Each of these is discussed in terms of the most current information available.

The chapter closes with a section that summarizes the software situation and presents some emerging trends in the areas already covered, as well as a mention of production consortia, purchasing rights, on-demand publishing (an educational requirement), and the crucial role of copyright.

An overall observation is that although it would be foolish to state that the success or failure of a telecommunications system hinges on the quality and availability of software, it should be noted that the finest possible system for transmission is uneconomical without adequate means for generating, acquiring, indexing, retrieving, and accessing already prepared content. Until some of the software problems are solved, only limited usefulness can be expected from a statewide distribution system.

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VII

SOFTWARE

No matter how advanced the state of technological development and how great the sophistication of telecommunications or other educational technologies, the final usefulness of these technologies to pupils and to professional personnel in the public schools is dependent upon the quality of software which is available to carry messages over the telecommunications system. It is the purpose of this chapter to discuss the problem of software in relation to the technologies which potentially can serve as delivery systems.

TERMINOLOGY

At this point, initial clarification of terminology and definition of the terms as used throughout the chapter seem imperative.

Software--In this chapter, software is used as a generic term to describe all learning/instructional materials which carry messages. Often the software requires a play-back or projection device in order to display the message it stores as interpretable audio, visual, or tactile information. For example, a motion picture film would be considered software in the generic sense of the term; a set of study prints or a pamphlet would also be considered software, as would a computer magnetic tape which stores information or instructional signals.

To avoid the confusion that might otherwise be generated by the differing semantics of computer technology, the following terminology will be used in relation to computers:

Computer software--meaning the programs, control, and operating systems required to use a computer for a given purpose.

Computer courseware--then, refers to that portion of a computer program which carries the instructional content and/or activities, in contrast to the software which controls the operating system.

Standards or standardization--This term will be used to refer to specifications set either nationally or internationally, usually on an industry-wide basis, in order to standardize certain elements of hardware and software and thus to make the products of different manufacturers interchangeable. An example would be the half-inch Electronic Industries Associated of Japan (EIAJ) format for reel-to-reel video tapes, or the Phillips audio cassette.

Hardware--While originating in the computer industry, the term hardware is often used educationally to connote any playback/projection equipment necessary to use a given item of software or the necessary computer configuration required for given programs. In referring to non-computer hardware, the term equipment will often be used in this chapter.

Validation--This term refers to the process by which software is tested, analyzed, revised and adjusted, and re-tested to be sure it meets objectives, before it is made available on a large scale.

Consumables--This term refers to items which comprise a part of many sets of learning/instructional materials but which are consumed in the process of using the materials and must be replaced if the learning/instructional materials are to be used over a period of time. Examples would be worksheets, tests, and certain types of programmed instruction, filled out by students and/or teachers.

CURRENT STATUS

Software (learning/instructional materials) is widely available throughout the United States, both from commercial producers and as teacher-produced or school-produced materials.

Producers/Publishers

The latest National Information Center for Educational Media (NICEM) Index to Producers and Distributors (1973) lists approximately 9,000 producers and distributors of educational software. Although some of those 9,000 are distributors only and others are producers and distributors of free or promotional materials, the major proportion are producers and/or distributors of software for use in educationally related technologies. The NICEM index does not include book and journal publishers. It should be noted, however, that according to the 1972 Educational Media Producers Council report approximately 88 percent of the total production and sales of software is carried out by slightly over 100 producers. (McCaffrey, Educational Media Yearbook, 1973)

According to the most recent American Book Publisher's Council reports, there are currently some 3,125 publishers of text and trade books, and 9,681 journals are published annually. (Publisher's Trade List Annual, 1974; Directory of Publishers of the National Association of College Stores, 1975; Ayer's Directory of Publishers, 1975) Thus, it is evident that there is no shortage of firms engaged in the process of producing software for the educational market.

Commercially Produced Materials

The most recent edition of Hope Reports, released in January, 1975, indicates that sales and services in the equipment and software industry increased 14 percent in 1974 over the previous year. (AV Guide, 1975)

The previously mentioned 1972-1973 EMPC survey indicated that approximately 25 percent of the retail sales of media software were at the district level and for film library operations, and that approximately 75 percent went into school building level collections. These figures do not include books and journals. The 1972 sales figures at the building level are double those of 1968. By level of school, the sales breakdown is elementary 59 percent, secondary 34 percent, and colleges and universities 7 percent.

The survey also estimated that of total school expenditures, approximately 80 percent were for textbooks and trade books and 20 percent for media software and equipment. Five-year figures indicate that the percentage of expenditures devoted to media software has increased each year since 1968.

Sixteen millimeter films continue to account for a high percentage of the market (25 percent in 1972), although the long term trend for them is downwards. Silent filmstrips have declined in sales, but sound filmstrips have increased markedly. Multi-media learning kits rank third in their percentage share of the total audiovisual media market (12.7 percent). Phonodiscs (records) still outsold audio tape cassettes in 1972, but the ratio was declining. Tables VII-a and VII-b display some ongoing trends in share of market and audiovisual vs. textbook sales. Tables VII-c and VII-d indicate changes in sales by subject area and by grade level between 1971 and 1972. Unfortunately, more recent figures are not available.

SHARE OF MARKET (percentage)*			
	1966	1971	1972
District Level and Film Library Acquisition:			
16mm (black and white)	9.4%	3.4%	3.1%
16mm (color)	29.9	23.7	22.1
Total District Share of Market	39.3	27.1	25.2
Building Level Acquisition:			
8mm (silent)	1.9	4.1	4.4
8mm (sound)	---	0.3	0.3
Filmstrips (silent)	27.1	9.6	8.4
Filmstrips (sound)	4.6	18.6	19.6
Overheads	8.5	4.8	4.9
Slides	1.0	1.3	1.2
Records	4.7	4.4	3.7
Prerecorded Tapes	3.4	8.9	9.7
Study Prints	4.1	5.2	4.6
Multi-media Kits	3.1	11.4	12.7
Other Products (discontinued category)	2.3	---	---
Games, Manipulatives, and Realia	---	4.3	5.3
Building Level Share of Market	60.7	72.9	74.8
TOTAL	100.0%	100.0%	100.0%
Internal Ratios of Subformats:			
Audio in Record Version	100.0	66.7	58.1
Audio in Cassette Version	0	33.3	41.9
Reel-to-Reel	100.0	21.5	13.9
Cassette	0	78.5	86.1
A-V Oriented	100.0	51.1	54.8
Print Oriented	0	48.9	45.2

*Selected item from 1972 EMPC survey © NAVA, Inc., 1973, as quoted in Educational Media Yearbook, 1974, p. 116.

Table VII-a

AUDIOVISUAL vs. TEXTBOOK SALES*

	Sales (expressed in millions)			Percentage of Increase	
	1966	1971	1972	1966-72	1971-72
Audiovisuals	$118.0	$193.7	$214.7	81.9%	10.8%
Share of Market	14.2%	18.1%	19.7%		
Textbooks	$711.5	$877.7	$872.9	22.7%	0.6%
Share of Market	85.8%	81.9%	80.3%		
Combined Sales	$829.5	$1,071.4	$1,087.6	31.1%	1.5%
	100.0%	100.0%	100.0%		

Table VII-b

SALES BY SUBJECT AREA*

	1971 Sales		1972 Sales	
	$ (in millions)	Percent	$ (in millions)	Percent
1. Language Arts	$34.3	35.9%	$39.3	35.7%
2. Social Studies	17.3	18.1	20.2	18.3
3. Science	16.3	17.2	17.4	15.8
4. Mathematics	6.6	6.9	8.7	7.9
5. Guidance and Health	6.2	6.5	7.4	6.7
6. Vocational	4.8	5.1	6.5	5.9
7. Music and Art	4.2	4.4	4.2	3.8
8. Other Products (discontinued category)	2.9	3.0	3.7	3.4
9. Foreign Languages	2.8	2.9	2.7	2.5
TOTAL	$95.4	100.0%	$110.1	100.0%

Table VII-c

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*Selected items from 1972 EMPC survey © NAVA, Inc., 1973, as quoted in *Educational Media Yearbook*, 1974, pp. 116-117.

SALES BY GRADE LEVEL*				
	1971 Sales		1972 Sales	
	$ (in millions)	Percent of Market	$ (in millions)	Percent of Market
Elementary	$62.5	57.0%	$72.5	58.6%
High School	36.9	33.7	42.4	34.2
College	10.2	9.3	8.9	7.2
TOTAL REPORTED	$109.6	100.0%	$123.8	100.0%

*Selected item from 1972 EMPC survey ⓒ NAVA, Inc., 1973, as quoted in Educational Media Yearbook, 1974, p. 117.

Table VII-d

The Association of American Publishers estimates that of the extremely varied output of publishing, textbooks still comprise by far the largest part, but that trade books reached a high of 21 percent of total publisher's output in 1973. It also notes that most traditional book publishers no longer limit themselves to books, but also provide many types of educational software. Total sales of $1.4 billion in 1973 are broken down as follows (Engelhart, Educational Media Yearbook, 1974):

Textbooks/workbooks, all levels	$809 million
Audiovisual and other media	206 million
Mass market paperbacks	72 million
Trade books	301 million
Subscription books	15 million
Maps	12 million
Tests	23 million

Although the sales figures do not indicate numbers of items in each category, they are useful in identifying relative proportions of funds being expended by education on materials that are commercially produced.

To summarize, software spending by schools and other educational purchasers continues to increase each year. Motion pictures continue to be the major item in terms of dollar volume, followed by video, sound filmstrips, audio, and slides. Unfortunately, the reports available do not release the actual numbers of each type of item that are purchased. In 1973, the following annual expenditures per student on software were estimated by Hope Reports for various levels and types of schools (Hope, Educational Media Yearbook, 1974):

Private schools	$4.07
Roman Catholic parochial schools	3.09
Public schools	4.84
Two-year colleges	41.00
Four-year colleges	30.00
Medical schools	461.00
Dental schools	330.00
Nursing schools	73.00

One must conclude from the foregoing that extensive production of learning/instructional materials is going on, and that in many subject areas there is a wide variety of software from which teachers and other professionals may select, provided they have funds to purchase the materials. Unfortunately, however, in perusing producers' catalogs, examining their displays and exhibits, and previewing samples of their materials, one finds that there is extensive duplication of both subject and level among the materials produced and marketed and that there is a dearth of materials suited to particular kinds of learners and to certain levels of schools. The quality of the software varies extensively, from superior to hardly worth the film or tape it is stored upon.

Thus, there are wide gaps in availability of materials of many types which must be filled locally. One major reviewing journal, Booklist, which is highly selective and which prints reviews only of recommended materials, reviews only about two percent of the media produced in a given year.

School-Produced Materials

No figures are currently available concerning the quantity of materials produced by teachers within individual schools or by media specialists in district and regional service center laboratories. Observation in schools, however, would lead one to conclude that in some districts there is considerable production, while in others it is discouraged and little that is not commercially available is prepared for student use.

Often locally produced materials do not have the polish of commercially produced materials, but they do have the added advantages of immediacy, relevancy, specificity to local learning needs, and potential for more rapid validation and revision.

The advantages and disadvantages of locally produced software are succinctly described by Bretz (1972):

Advantages:
1. Can respond quickly to local needs
2. Can be highly specific; tailored directly to instructional needs
3. Can be rapidly evaluated and revised
4. Is more democratic
5. Tends to be better used

Disadvantages:
1. Low quality
2. Limited to simple studio techniques
3. Costs when including teacher time may be higher
4. Has low commonality and little transferability

Bretz discounts the quality disadvantage in discussing technique but not in discussing content; he suggests that while producers of commercial materials often claim to have advantages in effecting attitudinal change because of the slick quality of their production, locally produced materials may in the long run be more effective in this respect because of their specificity to local needs.

Costs of Learning/Instructional Materials

The actual dollar cost of software varies from the one dollar spent on an art print to the hundreds of thousands of dollars required to design, validate, and implement a course of computer-assisted instruction in a given area. Therefore, a more useful way of examining costs would be to assess the cost of a given item per pupil hour of instruction that it can provide. Such cost figures have been developed, especially for computer-based instruction (which often runs as high as $10 per student hour) but little has been done to determine the actual costs of other materials. For example, how cost-effective is a book with a price of $7? Considering that its useful life may be up to ten years, that many pupils may use it during that time, and that each may spend a different amount of time using it, the actual cost per pupil instructional hour is almost impossible to measure but would undoubtedly be very low (provided that pupils can read and decode the book's content). The same problem exists for a chart posted on a bulletin board where thirty or more pupils may view it for varying numbers of minutes or seconds over a period of several weeks.

Thus, little hard data exists on costs of most materials other than initial purchase costs. Further data are needed on maintenance costs, circulation costs, and costs in relation to instructional effectiveness.

Quality and Validation

Few learning/instructional materials on the market at the present time provide the user with any assessment of effectiveness or validation data. Computer-based educational materials are the main exception to the above statement. More and more producers of learning systems for given subject skills, such as reading, arithmetic, and oral comprehension, are beginning to attempt some field testing of materials and subsequent revision before putting large, expensive systems on the market. Most materials purchased at the building level, however, have undergone little validation or testing. Glaring examples of lack of validation have occurred, such as an electronic video recording project in Nassau County, New York, in which the producers/distributors of the software were not even cognizant of the actual content of some of the materials that were marketed to the consumer in a package deal.

COMPUTERS IN EDUCATION

Instructional Applications of Computers

Special consideration should be given to computer software and courseware both because of its complexity and because of its unusual potential in education. A variety of terms have been applied to instructional uses of the computer, with the earliest universal term being computer-assisted instruction (CAI). Later terms have included computer-managed instruction (CMI), which seems to be the term currently preferred, as ongoing research efforts emphasize the CMI aspects of computer use, e.g., student record management or development of quizzes from questions stored in a computer data base. In describing the more detailed or specialized applications of CAI or CMI, the following modes of instruction have been accepted by most educators and are most commonly used.

Drill and practice. Drill and practice instructional sequences usually use multiple choice questions which a student must answer correctly before proceeding to the next frame; other variations include filling in a word or a phrase where there is a blank portion of a statement. A student answering incorrectly more than twice is branched to a remedial (review) portion of the course. Many elementary school CAI materials in reading and mathematics are in the drill and practice format.

Tutorial. In the tutorial mode the student carries on a conversation with the computer in much the same manner as a Socratic dialogue. The dialogues may be enhanced by computer-generated graphics displayed on special terminals or by augmented display devices such as a microfiche projector. This format generally is used with precise disciplines such as physics, chemistry, and biology.

Learner controlled (inquiry) mode. In some experimental CAI courses, a very sophisticated learner controlled capability to specify all parameters of course matter and to provide manipulative (mathematical) skills has been built into the lesson. The student then has complete control of his/her own individualized instructional session. Merrill, at Brigham Young University, is expanding research on learner control with the course materials being developed for the TICCIT system.

Laboratory uses of computers. A great many schools and universities are using the computer to simulate laboratory experiments as a supplement to instruction after the student has had some "wet lab" experience. The manipulative skills are played down and the concepts involved are presented to the student. Calculations for complex mathematical problems are performed by the computer, allowing the student the time to master the basic concepts required. Many universities have adopted mini-computers for use in analytical laboratory procedures which undergraduates are performing as part of their instruction.

Simulation and gaming techniques using computers. One of the most effective computer teaching methods involves the use of simulation or gaming techniques. Modeling "real world" situations on a computer has aroused widespread student interest and enthusiasm, so that the introduction of games may be one of the most entertaining and practical ways to overcome "computer illiteracy." Computer games now in existence include aerial dogfights, ping pong, chess, checkers, craps, chuck-a-luck, 21, National Football League, moon war, artillery, and many more. In the area of simulation, there are some very accurate and fine programs covering macro-economic models, pollution, population, genetics, etc.

Problem-solving. The use of the computer for problem-solving is one of the most widespread instructional modes, particularly in the sciences and in engineering. Papert (1971), using LOGO, a non-numeric computer language, and a control device called a "TURTLE," has conducted experiments with first and second grade children in computer-based problem-solving. "TURTLE" itself is like the "joy stick" of an airplane; it not only can send simple commands to the computer, but also can receive commands. It can be hooked up to an auxiliary device which, under computer control, can draw geometric designs of simple figures, solve physics problems via graphic output, etc. Papert has demonstrated through these experiments that elementary school students can learn to write programs and instruct the computer to perform specific tasks.

Evaluation and Guidance

Computers are now used widely to score and evaluate multiple choice and similarly formatted tests, using either mark-sense reading or optical scanning techniques. The field of computer-assisted testing has developed as a specialized area, within which several comprehensive guidance and counseling programs have been written. Examples of such programs are the Information System for Vocational Guidance (ISVG), developed by Harvard University, and New England Education Data Systems (NEEDS). The American Institute for Research is presently developing a computer-based guidance system called PLAN.

Administrative Uses of Computers

Administrative uses of the computer have existed since the very beginning of computer systems applications in the late 1950's. Automation of budget, payroll, property management, inventory control, personnel records, transportation schedules, and scheduling and registration for classes is now fairly commonplace in larger school districts and higher educational institutions.

Management and Information Systems (MIS)

Development of large data bases within educational institutions would not be possible without the rapid storage and retrieval provided by the computer, and incisive analysis of budgets, operating costs, and forecasts is dependent upon the existence of an accurate, complete, and up-to-date data base. To be successful and fully efficient, computerized information systems must be part of an integrated total system which also includes instructional records.

Library Storage and Retrieval Systems

The role that the computer plays in the development of automated library storage and retrieval systems for educational institutions is a very important one. Through the use of the computer, bibliographies and research abstracts as well as reference materials used in class can quickly be searched, segregated, and listed to serve a wide variety of purposes. Libraries by nature are well organized, and university information systems would normally use this kind of operation.

The Problem of Transportability or Successful Delivery Systems in Education

Despite the fact that much material has been generated for instructional applications using computer techniques, the most serious problem (other than that of CAI developmental costs) has yet to be solved: how do we get this material into the hands of teachers and students without incurring complex technical difficulties with regard to computer and program compatibility? Thus, the problem of transferability requires consideration in determining potential computer applications and solutions, where such needs exist. This problem is discussed in somewhat more detail later in this chapter.

Computer Software and Courseware

The use of the computer as a teaching aid is relatively new in education, with the first efforts originating in 1958. Prior to the 1970's, the use of computer-based instruction in public schools had been more expensive than traditional classroom instruction (as high as \$10/student hour for CAI vs. \$1.25/student hour in the classroom). The most drastic change that has since taken place occurred in 1974, with the advent of more powerful and less costly time-sharing mini-computer systems specially designed to handle instructional applications. This breakthrough has lowered operating costs to slightly above \$2.00 per student hour. It is possible at the present time to purchase a complete 16-terminal time-sharing system with sufficient core memory and auxiliary disc storage for approximately \$50,000. This system is designed to use BASIC or other programming languages.

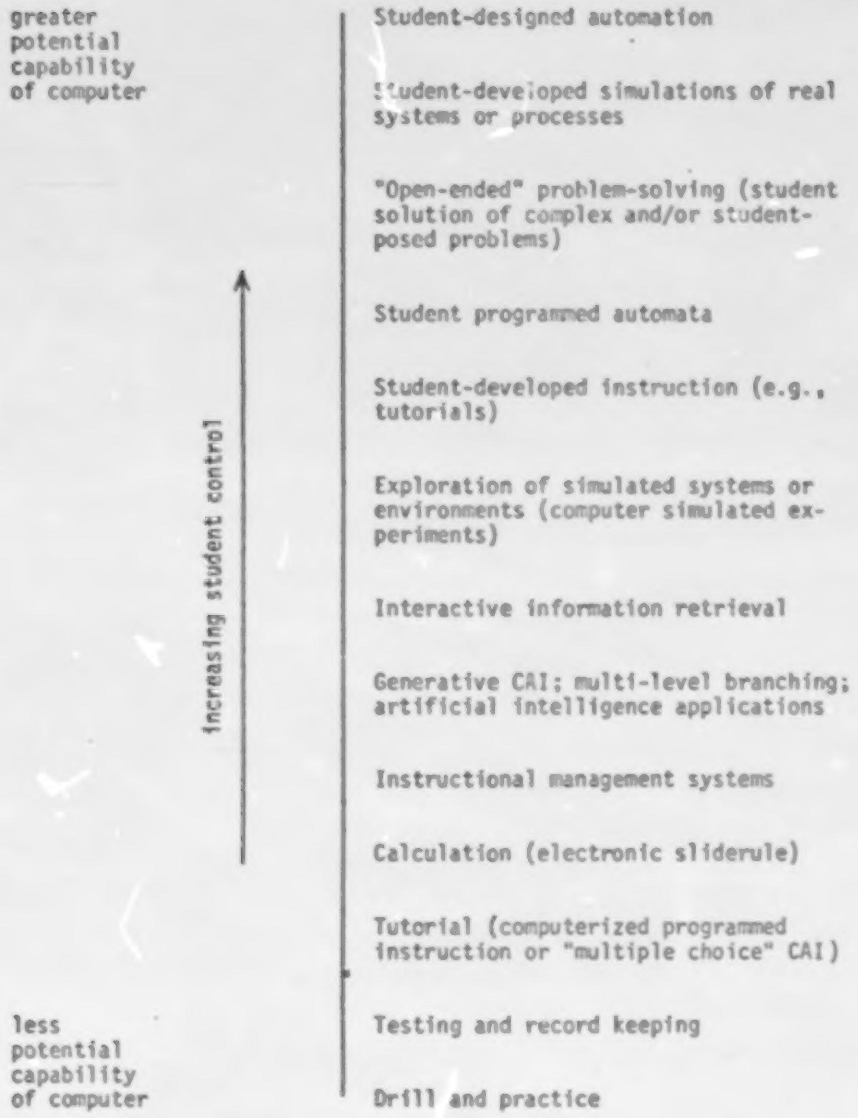
However, while a time-sharing system with computer software that has been proven effective is now available, there are still several important problems that remain to be solved. There is a need for quality courseware that not only is certified by a panel of educators but is modular in content and of excellent instructional design; course content should include instructor and student guides as well as technical (computer) program documentation. To this end, several computer manufacturers have voluntarily fostered a clearinghouse of usable interactive programs in BASIC computer language, listed by discipline and source, and a clearinghouse of in-house-supported courseware that will have a longer viability. Specific examples of this effort are the Hewlett Packard Corporation Curriculum Clearinghouse listings of BASIC programs and the Digital Equipment Corporation support, duplication, and sale of the Huntington Project BASIC materials in a wide variety of subjects (mathematics, science, ecology, etc.) for high school and college level use. The Xerox Corporation is also fostering a similar "instructional material book" for computer-related teaching courseware.

The second major problem is that of teacher involvement in the integration of computer-based materials into traditional courses where they will increase teaching effectiveness. The "bridging function" required to accomplish such integration is by far the most complex and difficult problem that educators must solve, for the overcoming of faculty illiteracy regarding computers is a task of no small magnitude. It involves orientation and training workshops for teachers in order to instill confidence, to provide a fundamental understanding of computer applications in education, and to instill the feeling that the educator is in control of the situation at all times. Teachers presently tend to dislike and distrust computers because they do not understand them, and this attitude will not change until they are given the opportunity to familiarize themselves with computer technology. As administrators are unlikely to bring computers into their school systems in the face of extant teacher resistance, workshops may provide the only feasible opportunity for such familiarization.

The following figure (Milner and Wildberger, 1974) describes potential CAI uses in terms of task efficiency as related to various instructional applications. The most successful applications are those which utilize the computer for advanced techniques which are at the upper limit of the scale shown on the following page in Figure VII-A.

Statistically speaking, the most widely supported programming language in the world is FORTRAN, which is designed to be used by over 90 percent of computer manufacturers in a standard operating mode that is highly compatible. The constraint involved in using

CONTINUUM OF INSTRUCTIONAL USES OF COMPUTERS*


greater potential capability of computer
increasing student control
less potential capability of computer

Student-designed automation

Student-developed simulations of real systems or processes

"Open-ended" problem-solving (student solution of complex and/or student-posed problems)

Student programmed automata

Student-developed instruction (e.g., tutorials)

Exploration of simulated systems or environments (computer simulated experiments)

Interactive information retrieval

Generative CAI; multi-level branching; artificial intelligence applications

Instructional management systems

Calculation (electronic sliderule)

Tutorial (computerized programmed instruction or "multiple choice" CAI)

Testing and record keeping

Drill and practice

Figure VII-A

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*Taken from Stuart Milner and A. M. Wildberger, "How Should Computers Be Used in Learning?", _Journal of Computer Based Instruction_, Vol. 1, No. 1 (1974), p. 8.

FORTRAN is that it is designed to be used primarily on larger computer systems; thus, when FORTRAN is available for a minicomputer system it is normally restricted to a batch mode type of operation. The BASIC language, on the other hand, can operate in either a batch or a time-sharing mode when used with small computer systems. BASIC is easy to learn to program and easy to use, and it can do most of the tasks that FORTRAN can do except for high compute problems, large scale file handling, and matrix manipulation above a certain size. Its disadvantage, however, is that there are some forty different "dialects" existing among various computer systems. Although efforts are underway to develop a standardized version of BASIC that can be used just as standard FORTRAN is used now, this accomplishment is still in the committee formulation stages; Thomas Kurtz of Dartmouth College is chairman of the BASIC standards group, comprised of representatives from government, industry, and education.

Major Computer Networks Involving Instruction

A list of the major computer network projects in the United States is shown as Figure VII-8 (Greenberger et al., 1974). These are primarily regional information handling networks designed to provide a vast category of services ranging from conventional information processing to computerized switching of packets of information to computer-assisted instruction.

Summary of Computer Applications and Uses

In summary, there is today a great deal of interest at all educational levels in the use of computers as instructional aids. Programs for interactive instruction are being developed at innumerable institutions. Unfortunately, there appears to be a significant lack of transfer of materials between institutions. This lack arises for many reasons, but four major problem areas seem to present the most difficulty for transfer of program packages. They are:

(1) The lack of professional standards applicable to all educational computing systems and interactive programming languages;

(2) The existence of many versions ("dialects") of the same programming language;

(3) The lack of guidelines for educational and technical documentation of courseware; and

(4) The lack of a central library facility for cataloging, storing, replicating, and disseminating programs.

ISSUES AND QUESTIONS

Several questions arise in connection with software, and each deserves discussion when the possibility of implementing a comprehensive telecommunications network is considered. The crucial nature of what is to be transmitted through a system necessitates that each of the following issues be evaluated: copyright; standardization; FCC regulations; relationship to textbook adoption program; consumable materials; personnel; quality, validation, and transferability; distribution requirements; and evaluation and selection of software.

Copyright

If there is any single issue upon which the success hinges of using a telecommunications system to distribute learning/instructional materials it is probably that of copyright. Given the current copyright status, very few items of software, except those in the public domain (either never copyrighted or over 28 years of age), are available for distribution on a telecommunications network. Current copyright law prohibits distribution of software

MAJOR COMPUTER NETWORK PROJECTS

Name of Network	Principal Agency	Purpose
ARPA	Department of Defense Advanced Research Projects Agency Washington, D. C.	27 sites: computer to computer switching information handling network
ERIC	Educational Resources Information Handling, Stanford University Palo Alto, California	Educational publications, storage, and retrieval
TUCC	North Carolina Educational Computing Service Center, Triangle University Computing Center	Computation and CAI time-sharing network for 50 institutions
UNI-COLL	University of Pennsylvania Philadelphia, Pennsylvania	Regional network
CONDUIT	Consortium of Universities of Oregon, Dartmouth, Iowa, and Texas	Regional networks located at each of four universities for CAI transfer research
MERIT	Michigan State and Wayne State (Michigan) Computer Network	Computational and CAI network
MEDLARS MEDLINE	Medical Literature and Analysis Retrieval Network, National Library of Medicine Washington, D. C.	Medical research data base and file retrieval system
NERCOMP	New England Regional Computing Project, Massachusetts Institute of Technology Cambridge, Massachusetts	Consortium of educational institutions operating an inter-computer education network
OCLC	Ohio College Library Center Columbus, Ohio	Library information network to 48 colleges
MECC	Minnesota Educational Computing Consortium, University of Minnesota, Minneapolis, Minnesota	Statewide educational computing network for all applications
TIES	Minnesota Total Information Educational System	
TICCIT	Timesharing Interactive Closed Circuit Interactive Television MITRE Corporation McClean, Virginia	128 terminal CATV/CAI system installed at Brigham Young University and Maricopa Junior College
PLATO IV	Programmed Logic Automated Teaching Operation, University of Illinois at Urbana (CERL)	1000 terminal CAI system using plasma display technology and CDC-6400 computer
OTIC	Oregon Total Information System, Oregon State University	60 school district management and information systems network
MARK III	General Electric Company Information Services Division Bethesda, Maryland	2000+ time-sharing commercial network; largest in the world; in US and foreign countries
MARC	Library of Congress Washington, D. C.	Library information on books and periodicals

Figure VII-8

(often considered a performance) via any system without permission of the copyright holder. It also prohibits making more than one copy of materials for certain limited purposes without such permission.

Background. Current copyright law dates back to 1909 when Congress, acting under its authority to promote the progress of science and the useful arts, provided that authors and inventors might secure for a limited time the exclusive right to their respective writings and discoveries. The law was amended in 1972 to extend protection to sound recordings, and a new copyright bill passed the Senate in 1974, but failed to receive consideration in the House.

Thus, copyright is a statutory grant to a copyright owner of a complete monopoly over the copyrighted work for 28 years. It gives him/her sole control over the reproduction and sale of copies of the work in any form and the adaptation and use of the work in any medium. The work may not be printed, published, dramatized, translated, adapted, broadcast, or in any other way reproduced in any version without the consent of the copyright owner.

Fair use. The only exception to this monopoly is the use permitted under the doctrine of "fair use." Fair use is an attempt to strike a proper balance between society's interest in the use and dissemination of the information and the creator's pecuniary incentive to produce an intellectual property.

As negotiations on copyright legislation continue, it appears that the doctrine of fair use will be continued in some way, very likely in the form in which it appeared in S. 1361, the currently pending copyright legislation. S. 1361 states that the preparation of one copy of a given item by the intended user is "fair use," provided that four points have been taken into account:

> Limitations on exclusive rights: Fair use...the fair use of a copyrighted work, including such use by reproduction in copies of phonorecords or by any other means specified by Section 106, for purposes such as criticism, comment, news reporting, teaching, scholarship, or research is not an infringement of copyright. In determining whether the use made of a work in any particular case is a fair use, the factors to be considered shall include:
> (1) the purpose and character of the use;
> (2) the nature of the copyrighted work;
> (3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and
> (4) the effect of the use upon the potential market for, or value of, the copyrighted work. (S. 1361, Section 107, cited by Association for Educational Communications and Technology, 1973)

The Association for Educational Communications and Technology (AECT) has taken the strong position that the word "teacher," as it appears elsewhere in section 107, should also be interpreted as meaning media professional or other person dealing with learning resources. (AECT, 1973)

From the four criteria upon which fair use could be based, however, it is clear that the fourth would be easily violated by distribution of audio or audiovisual materials over a telecommunications system in which the state, each education service center, or each school district purchased one copy of a copyrighted work and then distributed further copies to schools via telecommunications technology.

Recent developments. The Williams & Wilkins case, recently decided by the Supreme Court, was expected to provide guidance for the future relating to the copying of works, but proved no landmark. Williams & Wilkins, a small medical and scientific publisher, challenged the right of two federal agencies, the National Institutes of Health and the

National Library of Medicine, to photocopy entire articles from their journals and distribute them to anybody without permission and without compensating the copyright owners.

The 1975 Supreme Court decision on the Williams & Wilkins case, which resulted in a 4-4 tie, has effectively tossed the copyright issue back to Congress for solution. At present, publishers/producers and librarians/educators continue to negotiate concerning proposed copyright legislation. There are persons in Congress and also in the courts who feel that the tie vote of the Supreme Court does not set a precedent giving a library or other educational agency permission to make copies of works for its patrons.

Others feel that since the court did not rule against the National Library of Medicine, the decision does set the precedent that copies may be made in limited numbers. It should be emphasized, however, that the Williams & Wilkins case referred only to copying of articles from journals and did not touch upon such items as audio tape, video tape, multiplying film to video tape, *ad infinitum*, although such an interpretation might be extrapolated from it.

In the case of computer materials, the copyright question is still more complex. One cannot *patent* a computer program, but since 1964 the U. S. Patent Office has ruled that computer programs* may be copyrighted through submission of two copies of a complete printed listing of the symbolic computer program plus two copies of the completed copyright registration form issued by the Patent Office, accompanied by a remittance fee of $6.00. At the start of the program itself must appear: (1) the word copyrighted (©); (2) the name of the author(s) or owner(s); and (3) the date of the program.

In addition, producers of proprietary computer programs often imbed in them "dummy" variables which do nothing but identify the programs when they are copied or plagiarized. Normally such insertions comprise non-print characters or functions which cannot be detected by the plagiarist, thus affording a greater measure of protection to the creator. (A similar kind of tactic frequently used by map manufacturers is to print the name of a town that does not exist in an unlikely place on a map. When someone copies the map, the detection of this town immediately verifies that the map has been copied.)

Thus, computer-based instructional programs can be generated and patented if a market exists which guarantees author protection as well as the provision of royalties from sales of quality software. With respect to the sale of programs and their unauthorized copying or purloining, if the body of the program copied is the same and it is determined that any changes made are non-essential (the program executes as originally designed), then the pilferer can be prosecuted and sued for copyright infringement. However, should a portion of the original program be copied and then changed in such a manner that it executes in a completely different manner, such a change is deemed to be essential and no infringement exists. It is a very complex and difficult process to determine what is essential and what is non-essential, and this has been the basis for initiating many law suits. The combined expertise of a computer consultant and a patent lawyer would be required on a case by case basis. Further, since so much curriculum material is in the public domain because of federal funding support for development, the author who creates an original block of courses under such sponsorship must radically change not only content but pedagogical strategies as well if he wishes to market such material at a later date. While no published guidance exists on this issue, it has been suggested verbally by one of the federal agencies (the National Science Foundation) that such changes should comprise at least fifteen percent of the program for it to be considered different from the original version.

Economic implications. Obviously, the economic implications of copyright for publishers/producers are enormous and the continuing availability of a wide variety of learning/instructional materials hinges quite critically upon the kind of protection and remuneration provided for designers, authors, and producers under the law. Indiscriminate copying will soon make the production of new works unprofitable and thus dry up the source of new materials. On the other hand, one may ask: to what extent does the public have a right to the contents of these works without actually purchasing them? Especially complex are the issues related to transmission of information through telecommunications systems and to storage and retrieval of information through computer-based data banks.

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*For this purpose, the term computer program is considered to comprise the machine language instructions, the educational content materials, or both.

In examining current materials, one finds all sorts of copyright statements designed to deter copying, none of which have any more legal force than a simple ⓒ or the word "Copyright" followed by the date. One of the more amusing appeared in a book titled *Toolchest* by Jean Adkins (1973):

> We have gone to considerable difficulty and expense to assemble a staff of necromancers, sorcerers, shamans, conjurers, and lawyers to visit nettlesome and mystifying discomforts on any ninny who endeavors to reproduce or transmit this book in any form or by any means, electronic or mechanical, including information retrieval systems without permission from the publisher. Watch yourself!

One accomplishment of Congress in 1974, even though copyright legislation was not passed, was the creation of a National Commission on New Technological Uses of Copyrighted Works. The Commission is charged with recommending changes in copyright law and procedures relating to the use of automatic information storage and retrieval systems and machine reproduction (other than that used by instructors in face-to-face teaching activities). No report has been made by the Commission to date.

Permission to copy. A particularly difficult aspect of copyright related to telecommunications is the ease with which electronically produced software can be copied electronically. High speed duplicators for audio tapes, audio cassettes, video tapes, and video cassettes have made it possible to reproduce multiple copies from one tape in a short period of time. Producers tell of sending programs out for preview, only to receive the preview prints or copies back, sometimes with a note still in the containers, telling the media laboratory to make X number of copies before returning. Obviously such procedures will completely destroy the possibility of previewing any items that may be copied electronically. While copying of film/projection based materials does occur, it is a more complex process and not as likely to happen as the copying of electronically produced items. Verbal print materials, of course, are subject to the same problems as electronic materials, because of the ready availability of copying machines in numerous locations and the possibilities of high speed copying.

Video piracy has increased in recent months as video tape copies of motion pictures are being produced by school systems. Unfortunately, the school systems often are not aware that they are doing anything wrong. In a field such as 16mm film, where overall sales are only in the hundreds of copies over a period of five years, such piracy is destructive of the producer's capability to continue to produce new films.. Wholesale copying has the potentiality to develop into a life or death matter for the motion picture and video tape industries; thus survival may depend upon authorized duplication.

With permission of the publisher/producer, copyrighted works may be distributed or copied, but the process of getting permission is extremely complex. Most producers simply do not have the administrative machinery, staff, or funds to grant permission to every school which asks, and therefore they ignore such requests. Others readily grant requests for a single copy. Others grant such requests with a fee attached, sometimes approximating the actual purchase cost--in order to discourage the copying.

Another problem related to permission occurs when a school or service center wishes to modify a commercially produced product in some small way for use in a local instructional program. Again, obtaining permission is the responsibility of the persons wishing to use the copyrighted material and becomes excessively time-consuming and expensive. Representatives of the Satellite Technology Demonstration in Denver stated that getting copyright permissions has been one of their most complex and difficult tasks, and the permissions granted were only for one year, although all work produced directly by STD is in the public domain.

Some producers have a Rights and Permissions Officer or a Contract and Copyright Officer. Others refer such questions to their Product Development Divisions, to Public Relations Offices, or to their attorney. The most usual impression is that no one wishes to make such decisions and that as a result much buck-passing goes on in the producers' offices. One producer scolded an educator wishing to use some of his material over the telephone (note: not in writing) by saying "Why did you ask? Why didn't you just go down behind the barn and copy it?" (Douglas, 1974)

Another problem crops up with copying when materials are converted from one format to another: do the same laws apply to converting pictures in a book to slides, discs to audio cassettes, filmstrips to slides, etc.? According to present copyright law, the change from one medium to another does constitute copying, and is prohibited without permission of the copyright holder.

Some school districts have entered into voluntary licensing arrangements with given AV producers, with each contract worked out according to the user's needs and the producer's system for computing fees and permits to duplicate. Such agreements usually result in much higher initial costs and generally have a time limit; neither aspect is really advantageous to either producer or consumer. The complexity of negotiating such voluntary licensing arrangements negates the possibility that individual arrangements can be made between producers and each school or district which buys copies of a work.

As a result, several producers of audio tapes are now including unlimited duplication rights for unlimited periods of time with the initial purchase of their tapes: Wollensak, Audiotext Cassettes, and Xerox are examples of companies currently marketing their audio cassettes in such a manner. Initial costs are usually between $18.00 and $25.00 for the first cassette purchased, rather than the cost without duplication rights of $5.00 to $10.00. However, the companies marketing their cassettes with duplication rights do not also market them without such rights. While such an arrangement may work for a relatively low cost item such as audio cassettes, it is questionable whether it would be workable for 16mm film or video cassettes.

The Granite School District in Salt Lake City, serving 73 campuses, has entered into an agreement with CBS News to videotape the nightly news broadcasts and make unlimited copies for use for 30 days, after which the copies will be destroyed. (Contrast this with the CBS suit against Vanderbilt University, which has been copying the same broadcasts for archival purposes but without contract or permission.) Dr. Donald C. Hess in Granite City has been a pioneer in licensing agreements with producers to allow specific copying of works in the video cassette format, and has won the respect of many producers for his professional approach to the copyright problem.

Electronic and other guards against copying. Attempts have been made to develop guards which may be placed on tapes to prevent unauthorized copying by scrambling signals. The TAV Copy-Guard System, for example, has been introduced as a process to halt unauthorized video tape copying. The system is not for sale, but Trans American Video is offering a duplicating service to producers who want to be assured that their video cassette programs will not be dubbed. Each TAV-copied tape carries an encoding signal which prevents copying, supposedly by breaking down a reference code used by recorders in dubbing. TAV has requested FCC permission to test the system in preventing off-air copying of broadcast and CATV programming. The cost to producers of having TAV dub tapes is $2.50 per tape to get the encoding signal protection. Since this would provide protection to video tapes but not to films, such a development might possibly result in producers' moving exclusively to video rather than film for audio/motion/visual programs. ("Systems Developed to Halt Videopiracy," *Educational and Industrial Television*, 1975) In addition, the Xerox Corporation has perfected a technique of coating documents with a special chemical which becomes activated when exposed to the fluorescent light of a copying machine and obliterates the entire copy during its exposure.

Standardization

When a statewide system of telecommunications is considered, the issue of standardization of equipment and software also raises its ugly head. While some formats of message-carrying media are fairly well standardized, others are not.

The standardization process. Basically, standardization may occur in several ways. In some industries, competition among manufacturers for a given educational and consumer market simply determines which format will be adopted. A good example is the 2" by 2" slide, which finally became standardized after Kodak took it to the consumer market; it is almost impossible to purchase 3¼" by 4" slides or projectors today. Another current product which is likely to compete on the consumer market is the video disc, with the Philips/MCA system vying with that of RCA; undoubtedly, educational materials will adopt the format which the consumer market adopts because of the advantages in programs, costs, availability of playback equipment, and service.

For some products, industry-wide standards have been established. The best example here is the half-inch EIAJ video tape format, which contributed greatly to the standardization of helical scan reel-to-reel video tape. ("The Half-inch EIAJ Standard Gets a Boost," Educational and Industrial Television, 1975) Such standardization by the industry has not occurred, however, in the case of video cassettes, although the most popular format today is the U-matic, principally because of aggressive marketing by Sony.

Standardization may also occur through work by producers, manufacturers, and professional organizations with the American National Standards Institute (ANSI). Often this is a long, tedious process; for example, only in 1974 did the interested parties finally reach agreement to try to reach further agreement on the 8mm film format. It is possible that with intensive promotion of Super 8 film with magnetic sound, this format will become standardized by the consumer market while negotiations with ANSI are still underway.

Standardization of computer systems. One significant obstacle to the transfer process in the field of computers has been the lack of hardware and software standardization between programs. Several attempts to solve this problem have been made. Many important contributions in the form of highly specialized technical computer standards have been formulated and implemented in the last ten years through agencies such as ANSI in the form of standards for FORTRAN known as the x 3.9-1966 Standard FORTRAN programming language. Similar standards for data communications were also formulated and published in 1965 by ANSI and designated as the American Standard Code for Information Interchange (ASCII Code) for digital data transmission. In the development of new hardware devices and techniques, a dynamic and fast-moving field, technical standardization often lags four to ten years behind marketing of the technology.

Problems for the state. One main problem that arises is the question of whether the state will be in the position of endorsing the product of one manufacturer over that of another if it adopts one format from among those which are not standardized and makes software available in that format to all schools.

A further problem is the question of local control of educational content and processes. If, indeed, a statewide standard is adopted, it automatically precludes the availability of certain software without requiring local school districts to bear the total cost of such purchases from local funds.

If, on the other hand, the state decides to produce and/or provide software and services for a format which is not standardized, does it have the obligation to produce and distribute programs in all formats so that each district will be able to obtain the programs in that format which is most compatible with its own equipment? If so, this could result in costs and personnel requirements which would remain open-ended.

The problem of obsolescence also arises, and attention should be given to the findings of Project C-BE, a jointly funded research project involving the University of Texas and the National Science Foundation in development of curriculum and use of techniques for computer-based education at the university level, that the effective shelf life of any given computer-based instructional program is no more than three years. (Allan and Lagowski, 1975)

Federal Communications Commission

Because of the extensive powers of the FCC in regulating radio, television, telephone, and telegraph operations within the U. S., it must be taken into account as a factor in distribution of software. The state, or its subdivisions as potential licensees, will have to deal with FCC regulations. In fact, the question may arise as to whether the state itself may actually be licensed for such a system, or whether it is necessary for it to create an independent authority for educational communications.

In the past, FCC regulations have been favorable to educational broadcasting and other telecommunications. The reservation of VHF or UHF television channels for educational broadcasting and the requirement that the cable systems of cities comprising the top 100 television markets must provide public access as well as educational channels have been advantageous for the development of telecommunications.

The stipulation imposed upon cable operators is to be reviewed and re-evaluated in 1977, however. In an attempt to assess current usage of the cable channels dedicated to educational purposes, Jorgensen and Anderson completed a study in the spring of 1975 under the auspices of Michigan State University, the AECT Division of Telecommunications, and the National Cable Television Association. Just released, the study shows that out of 6,000 cable systems examined, 350 indicate some type of educational use of television. Public elementary and secondary schools comprise 62 percent of the educational users, and higher education institutions, 37 percent. Of all the users, 64 percent used TV without budget increases and 74 percent hired no additional personnel. A total of 344 TV courses were listed, and 46 percent of the respondents indicated that they used TV for direct teaching.

In their summary, the investigators stated that educational use of CATV is not as frequent nor as active as the potential for it would permit. They further stated, "The key appears to be software. While CATV is viewed by many educators as a new distribution medium for software acquired from external sources, production of software at the local level is significant and apparently growing." (Jorgensen and Anderson, 1975)

Study findings revealed that no institutions were using CATV in an interactive two-way instructional mode. Of those which used TV for direct teaching, 39 percent produced their own programs, 18 percent purchased or rented programming, and 13 percent produced lessons in cooperation with other institutions. Another 29 percent indicated that they used programs received off-the-air from public or commercial TV stations.

While the study indicated that actual use falls far short of potential, it did recommend continuing reservation of channels for educational purposes and possible expansion beyond the 100 largest market areas.

Relationship to Textbook Adoption Program

Since in Texas the textbook adoption program provides free textbooks to pupils for most courses taught in the public schools and also allows local districts some discretion concerning their choice of textbooks, the possibility of a similar program for specific types of software to be carried on a telecommunications system must also be considered.

According to current law, however, a textbook is defined as hardbound printed materials, although some exceptions have been made in adoption of text materials for kindergarten and of certain paperbacks. Thus, the type of software needed for a telecommunications system very likely does not fall into the textbook category. Accordingly, should the state wish to set up an adoption program for such materials, new legislation would be required.

Present practice for all software except textbooks appears to be to leave its selection entirely to the discretion of the local district (with advisory assistance from the state or from education service centers, if requested). The local district may, then, delegate professional personnel engaged in working with learning resources to select the software which is to be purchased out of instruction budget monies, usually from local funds, since there is no state per capita funding for software other than textbooks. In addition, since adopted textbooks often are accompanied by a considerable amount of software in addition to the teacher's manual, it is currently the responsibility of the district to provide any of these learning aids related to adopted texts if children are to have the advantage of learning from the accompanying software. There may be some question as to the legality of this practice, since it denies such materials to pupils in less affluent districts.

Since there is such tremendous variety in software, three questions, in particular, appear to be worth considering: (1) Are there software items that are best left up to the local district to provide? (2) For locally selected and purchased software, should state lists of recommended items be used? (3) For certain types of software, including those needed in a telecommunications system, should some kind of adoption program be established?

Because of the tremendous variety in cost, learning effectiveness, format, ease of acquisition, ease of local production, and simplicity of maintenance, it appears that local districts should have considerable input into the selection of many software items. In fact, not only at the district level, but also at the individual campus level, software needs may differ extensively, thus reinforcing the need for individual school and teacher input into the selection of these items. Examples of such software would be trade books and study prints, pamphlets, some audio discs or cassettes, art prints, filmstrips, overhead transparencies, slides, certain types of kits, and other such less expensive yet readily available items. It should be noted that most of the items used as examples of local selection and purchase are either print, photographic, or electro-mechanical; they are simple to operate, easy to preview, relatively inexpensive, and the equipment usually is easy to maintain. Most school librarians are sufficiently prepared in the selection and acquisition of such software items that logistic problems are minimal, provided that campus level personnel want to use the items. The major problem related to such software in many less affluent districts is the cost. While many of the items are no more costly than trade books, two factors, in particular, mitigate against their use on some campuses: (1) cost of equipment with which to play back or project the software; and (2) state and regional accreditation standards and state/national standards for media programs which tend to focus on a certain number of books per capita, thus placing top priority on book purchases when funds are limited.

Some changes are currently evident in state standards. The new national standards, set forth in Media Programs: District and School (Association for Educational Communications and Technology and American Association of School Librarians, 1975), tend to recommend software without emphasis on one format or another. It would appear that the less complex, more cost-effective items of software should be purchased at the campus or district level rather than become a part of a statewide adoption scheme.

The second question, whether the Texas Education Agency should require materials that are locally purchased to be chosen from a statewide list of recommended items, would also appear to elicit a negative answer. Many states which have a shortage of professionally prepared learning resources specialists or librarians choose to exercise some control over selection of materials by a statewide list of items that are recommended for purchase; North Carolina is a good example. Certain advantages accrue to statewide provision of selection lists: screening by evaluators who may be more knowledgeable than local teachers or librarians, thus insuring quality of production and valid communications techniques; simplification of ordering and accounting procedures; and considerable uniformity of the instruction provided in schools throughout the state. At the same time, certain of these potential advantages may also be potential disadvantages. In Texas, the wide ethnic, cultural, and geographic diversity of target populations would suggest that items appropriate for pupils in Wink may not be appropriate for pupils in Port Arthur. As reviewing and bibliographic control procedures for software improve and as more and more districts are employing librarians/learning resources specialists (even at the elementary level), it would appear that sufficient skill is available to evaluate materials locally, particularly if administrators are willing to delegate evaluation and selection responsibility to personnel trained for such tasks.

A second potential disadvantage of statewide selection lists for non-textbook items is the possibility that the principles of local control of education and of the academic freedom of teachers and other professional personnel may be violated. If control of education is to be local, then selection of learning resources should also be made locally. While public school teachers may not often raise the issue of academic freedom, practicality and experience should dictate that materials which are not desired and chosen by teachers may not be used very effectively, may be ignored, or may be misused.

There may be a middle ground, however, between complete state control of selection of non-textbook items and complete local control. Much of the software required in a telecommunications system is complex, difficult to produce, and expensive. It seems reasonable that careful attention should be given to statewide provision of certain formats of software such as broadcast or cable television programming, computer software and courseware, video recordings, interactive television, simulators, computer magnetic tape, etc. Since state purchase of such commercially produced items and distribution through a telecommunications system would seem to violate copyright restrictions at the present time, it appears that the state has two alternatives: (1) to produce the materials that it desires for a telecommunications system and then to distribute them either directly or in network fashion through the education service centers; or (2) to provide some type of adoption program, similar to that used for textbooks, through which commercial producers will prepare and produce materials and submit them for possible adoption, recognizing that adoption would automatically carry freedom from copyright restrictions and distribution rights for the state. Should either alternative be chosen, care must be exercised to make the content and methodology of the materials such that they do not impose additional content and time requirements upon already harried teachers, but that they do better some of the tasks which the schools are called upon to do, especially in the areas of instruction in fundamental skills and individualization of learning programs according to student needs.

Consumable Materials

Because many of the multi-media programs, often called learning systems (for example Sullivan, Fountain Valley, Peabody, American Guidance Associates, Science Research Associates), include software in a variety of formats along with teacher instructions and pupil workbooks, worksheets, record-keeping booklets, or duplicating masters, there is often a need to replace consumable materials.

Most vendors probably assume that such replacement of consumable materials will be carried out by re-ordering the materials from the vendor or his representative. In practice, this sometimes becomes difficult to do for several reasons. First, the replacement of consumables so that there is always an adequate supply on hand for pupil use requires rather careful monitoring of the rate and frequency of use of such materials. Many schools either do not assign this responsibility or assign it to an already overburdened librarian or audiovisual coordinator who simply does not have the staff or the time to devote to it. Second, there is frequently considerable lag between the time consumables are ordered and the time they are received, rendering the whole learning system inoperative while waiting for replacements. Third, the cost of replacing consumables is sometimes prohibitive for schools; either the original systems were purchased with federal or grant money which has run out and there is no local funding for such items, or else the districts have simply failed to budget for such items in their planning. Teachers are then faced with scraping up funds from sources such as the PTA or else purchasing the consumables out of their own pockets, neither procedure being to the advantage of the school. At times, the cost of replacing consumables seems inordinately high.

An alternative to the replacement of consumables is to reproduce them locally, a practice which may often be in clear violation of copyright law. Should it be possible, however, for the state, education service center, or local district to purchase learning systems which contain consumable materials under an agreement with the producer that such materials may be reproduced either on a fee basis or because the reproduction rights have been incorporated into the original purchase cost, the copyright problem could be averted. Other negative aspects of local reproduction of consumables are the poor quality of many locally produced materials, the time that must be devoted by some teacher to operation of the reproduction equipment, and the possibility of blue blindness in a small proportion of students and the subsequent problems if purple ditto stencils are used for reproduction.

Personnel

The production and utilization of software in a telecommunications system on a statewide basis make specific personnel demands which cannot be denied.

By following AECT personnel guidelines and paralleling quite closely those of the American Library Association, personnel may be divided into four levels: professional, associate (an ALA category only), technical, and clerical. ("Certification and Accreditation," Audiovisual Instruction, 1974)

Professional personnel. These persons are fully certified for their positions and usually hold at least a master's degree. The media professional may be engaged in media management at the building, district, regional, or state level; in media product development; or in instructional design and development. Clearly, a statewide telecommunications system would require professional personnel of all three types, with the largest percentage being media managers who operate at the building, district, or state level as learning resource utilization specialists. The media managers are being educated in both educational technology and library science programs in Texas at the present time.

Educational product developers are also being prepared; most of them, however, may not be able to meet all certification requirements because many of them are being educated in programs in schools of communication with emphasis on radio, television, and film; for many qualified people in this category, certification is a stumbling block.

Instructional developers are also being prepared in small numbers, but such skills usually demand experience and education beyond the master's and certification levels; most instructional developers would probably function at the district, regional, or state levels but would clearly be essential to implementation of wide production and validation of software for subsequent distribution on a statewide telecommunications network.

The findings of Project C-BE with regard to instructional development verify previous writings, and make a strong case for an instructional development team that would work on preparation of learning/instructional materials for input into a telecommunications system. The fact that developers go through essentially the same process of intent and rationale, design/analysis, design/synthesis, production, evaluation, and dissemination regardless of discipline or level would indicate that a process has emerged by which instructional development personnel can create materials for a system, whether it be computerized instruction, or some less sophisticated technology. (Allan and Lagowski, 1975)

Associate personnel. The library associate is a person holding at least a bachelor's degree but without professional library preparation. The associate may perform specialized tasks under the direction of a professional while at the same time supervising technical and clerical personnel. Examples would be a foreign language reader's adviser in a public library or an administrative assistant in an academic library. Few associates are employed in public schools, and this personnel category is under reconsideration by ALA at the present time.

Technical personnel. If production of software at the state, regional, district, or campus level becomes more widespread, the requirement for more technical level personnel will become pronounced. Technical personnel may function in production after professionals have determined basic instructional design, or they may function in the areas of maintenance and equipment operation, as in television production and broadcasting or distribution. Most technical personnel have formal education equivalent to an associate degree from a two-year college, although some may be holders of bachelor's degrees in specific areas. To date, state salary support does not provide adequately for this level of personnel; most must be paid from local sources. Although their responsibilities place them above the aide or clerical level in personnel classification, there is no state salary support at this level as yet.

Clerical personnel. Clerical personnel in media positions are usually trained on the job and may be funded through aide or clerical position allocations. In most districts, however, few such personnel are assigned to media software production or maintenance positions unless their salaries are provided by federal funds such as ESEA Title I.

It would be foolhardy to assume that a telecommunications network would not require additional specialized personnel, as well as additional personnel assigned to production and maintenance. Much on-the-job training will be required of all personnel in such a system, since the tasks may not be well-defined until the system begins to develop its pilot programs, and even when it is fully operational adjustments in personnel tasks and assignments should be expected.

In addition to production, maintenance, and utilization personnel, careful attention must be paid to re-education of teachers and other professionals if any telecommunications system is to be exploited to its fullest potential. This need is emphatically documented in the Needs Assessment chapter.

Quality, Validation, and Transferability

While the professional previews materials, and the journal reviewer may make subjective judgments on their quality, little hard data has been produced to indicate the actual effects and thus the proven quality of materials in producing learning in pupils. Many professionals have had the experience of rejecting materials which appeared for various reasons to be of questionable quality only to find that they were highly effective with given students. Little validation data is available to most purchasers of software concerning the learning effectiveness of the items they buy. While some producers make limited efforts to field test materials before marketing them, the economic demands of recovering extremely large front-end costs often force producers to market materials before they have been adequately field tested, much less revised on the basis of the field test data. However, it must be recognized that field testing is expensive, brings the product closer to obsolescence, and gives the competition a chance either to pilfer ideas or to market earlier.

A recent development in the validation of materials has come from the impetus generated by Komoski at EPIE in spearheading the National Learner Verification and Revision Task Force (LVR). The role of the task force was originally to clarify the process of verification and revision and to prepare guidelines for producers to use in the LVR process. The emphasis in the LVR process, appears, however, to be on revision or product improvement as a result of feedback from learners rather than on initial validation of materials before they are marketed. The work of the LVR task force has been short-circuited somewhat by legislation in California and Florida that is requiring validation of materials purchased for the schools in those states; the intention of this legislation is apparently to prove the worth of a product before purchase rather than to revise continuously throughout the life of a product. (Levy, 1975)

It appears that the validation area will be one of continuing conflict among legislatures, educators, and producers for some time to come. From an economic standpoint, the continuous revision of products (perhaps somewhat like that of encyclopedias) will be prohibitive to all but a few large, well-established producers. On the other hand, educators will have difficulty in determing what is worth measuring; how much improvement in learning as a result of using given materials is enough? Is the same improvement to be expected of the special education student with learning disabilities and of the academically talented student in a private high school? Another area of problems and conflict in the continuous validation of materials relates to the training that teachers must receive in order to participate in on-going evaluation, revision, and validation of products in the classroom. If producers are to carry out the validation process, they must have schools to use as field test sites, thus requiring teachers to have skills which they do not now possess. However, many educators, publishers, producers, and other media personnel anticipate more validation activity.

In a Delphi study done in 1974, Herring found that 80 percent of respondents expected that between 1981 and 1990 "Commercially prepared prepackaged instructional materials [would be] validated and purchasers [would be] supplied with full validation information." In addition, she found that 65.8 percent of respondents thought that during the same time period "Cost effectiveness data [would be] supplied for all commercially prepared learning materials." She also found that 56 percent of respondents thought that between 1974 and 1980 "Teachers [would] test and revise materials that they [prepared] in order to validate them for future use." (Herring, 1974)

Validation is also closely tied to the issue of transferability. Among the more complex examples is transferability of computer-based instruction, but problems similar to those cited in the following section also exist in transferring lower technology learning systems such as audio-tutorial, the Keller plan (Personalized System of Instruction), and others.

Transferability of computer software and courseware. The most promising work for fostering transferability has been accomplished by professional societies such as the Society of Chemical Engineers which, through a working committee, has organized and implemented the Computational Aids to Chemical Engineering in Education (CACHE). Within the CACHE System, FORTRAN IV was adopted as the programming language. Technical specifications were defined in a practical and precise manner from the standpoint of compatibility of compilers between commonly supported commercial computer systems. Unfortunately, only a finite number of highly specialized CACHE programs exist. (National Academy of Engineering, 1972)

A major breakthrough in information transfer has recently been achieved by the ARPA network, using information packets that are transmitted via high speed, precisely formatted digital data blocks between computers of dissimilar make through the use of special conversion devices called interface message processors (IMPS). This technique has been described more fully in the chapter on Telecommunications Activities in Other States.

Within the industry itself, many vendors maintain libraries of "customer furnished" programs; e.g., IBM has its SHARE group, Digital Data Corporation the DECUS educational library, Hewlett-Packard its users group, etc. The problem with this type of organization is that it limits the user to one vendor's system. To go to another system requires many changes in programming formats, some major, some minor.

The Department of Defense has conducted a research study on the problem of transferability of computer programs because of the need for full system compatibility in military operations. Several excellent reports on this subject have been published by the Rome Air Development Center, and include in-depth recommendations for programming language transferability standards on languages such as FORTRAN, COBOL, and JOVIAL. (Fleiss et al., 1972)

In evaluating the problem of why there is no widespread use of computer-based courses, the crux of the situation is that there has been little or no in-depth organization, publication, dissemination, testing, and evaluation of computer-based curricula on a large scale effort in a live environment. One reason for this possibly is that educators are notorious for not communicating directly with each other, even in the same institution. Levien (1971), in a study involving the plans for establishing the now extant National Institute of Education, stated "Serious deficiencies in information flow exist within the field of education." He was referring to the quality of the information transfer within institutions as well as to the inaccessibility of information. To illustrate this point, the following incident is recounted. During the 1970 Fall Joint Computer Conference held in Houston, Texas, several faculty members from the Chemistry Department of the University of Texas at Austin decided to conduct their own realistic survey on transferability of computer programs, using a benchmark program written in Extended BASIC (the General Electric Mark II version) on various vendor systems displayed in the exhibit area. The test program was written for Introductory Chemistry and contained some two hundred statements. Five of the vendors who were exhibiting their mini-computer time-sharing systems were selected and the company programmer personnel notified of the purpose of the experimental test. The results showed that none of the systems ran the complete program without error for the following reasons:

(1) Two of the systems had no provision for handling character string manipulation.

(2) All five systems had minor character set format problems involving statement identifiers; e.g., one system used "rubouts" for separation of statements while another used a colon.

(3) One system did run the entire program, but was not altogether successful, as the diagnostics on the "print" statement indicated a minor violation in format.

It is rewarding to report, however, that with the assistance of the particular vendor's system programmer, a sub-routine for conversion of the test program was written which converted the program to proper formats in less than one hour.

Important strides have been made in compiling, cataloging, and disseminating information on computer program availability through publication of an index of CAI programs by the University of Wisconsin (Hoye and Wang, 1973) and the U. S. Navy's publication of a cross-referenced KWIC index of articles on CAI. (Engel, 1969) ENTELEK, a non-profit corporation located in Boston, Massachusetts, has also published a list of CAI programs (1969). The Program and Literature Service (PALS) also has an extensive listing of computer-related curriculum materials available at the North Carolina Educational Computing Service (Hege, 1972), as does the Joint User Group of the Association for Computing Machinery. (McQuillin, 1974) These publications are very limited in scope; much more comprehensive coverage is needed.

In hopes of providing a solution to the problem associated with the transferability of computer-related curriculum materials, the National Science Foundation sponsored two projects with the goal of in-depth studies for improving transferability. In 1971, Project C-BE, co-directed by Dr. J. J. Allan and Dr. J. J. Lagowski, was initiated at the University of Texas at Austin to conduct research on the methodology for development of computer-based courses in a wide area of disciplines within the sciences and engineering. Its specific goals are:

(1) To identify computer-based concepts that are common among several disciplines;

(2) To develop evaluation procedures for this type of effort;

(3) To identify the elements of transferability;

(4) To develop a fiscal model.

The second project was Project CONDUIT, a consortium of five universities which is again discussed in the chapter on Existing Texas Networks. Project CONDUIT's specific aims are to achieve transferability by:

(1) Establishing repositories of computer-related curriculum on both a national and a regional level for the purpose of testing and certifying packages of instructional materials for dissemination to educational institutions;

(2) Publishing guidelines for creating computer-related curriculum materials;

(3) Publishing guidelines for documentation of computer-related curriculum materials;

(4) Publishing guidelines for evaluating computer-related curriculum materials;

(5) Publishing guidelines for transporting computer-related curriculum materials;

(6) Publishing guidelines for implementing computer-related curriculum materials;

(7) Publishing a listing of available computer-related curriculum materials;

(8) Holding workshops for training or orienting educators to the techniques of programming materials for computer-based curriculum;

(9) Using an advisory panel for certification of new or existing computer-related materials.

Also worthy of mention here is Project COMPUTE, conducted by Dartmouth College. This is a research project for curriculum development and transferability of documented CAI materials.

Admittedly, these activities are largely at the higher education level, where CAI is much further advanced. However, they are cited here to demonstrate that technical progress has been made and that the transferability problem has almost been surmounted in the computer field.

Software Distribution Requirements

Ideally, a telecommunications system would provide for the direct distribution of all software to the campus or even the classroom level. Realistically, however, it must be recognized that some sort of network must be established to handle requests for materials as well as to distribute them, and that various nodes in that network will have varying responsibilities in actually getting materials to the teachers and pupils who need them. Different types of information or materials may be better suited for the different levels of such a distribution network.

A preliminary list of potential computer network services. The following list suggests some possible uses for a network. (Greenberger, et al., 1974)

(1) Administrative

(2) Instructional
  (a) Computer-aided instruction (elementary, secondary, vocational)
  (b) Computer-aided instruction (college, professional, in-service, updating)

(3) Program Development and Testing
  (a) Basic instruction
  (b) Advanced instruction
  (c) Disciplinary instruction

    - (d) Network resource development
    - (e) CAI program support
    - (f) Cross-computer support

- (4) Computing
    - (a) General
    - (b) Large scale

- (5) Library and Literature
    - (a) Library catalog retrieval
    - (b) Current awareness bibliographic search
    - (c) Retrospective bibliographic search
    - (d) Research inquiry referral
    - (e) Network resource information

- (6) Data
    - (a) Statistical and survey data search
    - (b) Standard reference data search

- (7) File
    - (a) General data management
    - (b) Large scale data management
    - (c) Test file management
    - (d) Text analysis

- (8) Communications
    - (a) Teleconferencing
    - (b) Network interface conversion

- (9) Control and Data Collection
    - (a) Laboratory automation
    - (b) Network performance measurement
    - (c) Resource utilization analysis

Distribution service levels. The two primary service levels to be considered are the regional education service center and the campus level learning resource center.

> *Education service center*. A clarification of the specific role which is to be played by the education service center would seem in order. Is it to function as a depository of materials, as a node in distribution, as a site for storage and distribution of materials received from a central state source, or as an examination center which allows local districts or campus level personnel to examine what is available from a central state source? Each of the aforementioned roles would involve different requirements in terms of equipment, staff, software, and financial support.
>
> *Campus level learning resource center*. The assumption can be made that the campus level learning resource center will be a key node in the distribution chain. It is here that many learning/instructional materials will be housed, accessed, retrieved, and channeled to the ultimate user. Major advantages of transmitting materials to the campus LRC level for recording and storage are (1) immediate availability of materials provided through this arrangement, (2) the possibility of selection of materials by LRC personnel to meet the unique needs of pupils on a given campus, and (3) the informal and continuing contact with teachers and pupils that the staff of the LRC have. The major disadvantage is that LRC's are usually grossly understaffed with clerical and maintenance personnel, so that the professional must devote valuable, high-paid time to routine tasks just to keep the center operational. The quality of service varies according to the expectations of the principal on a given campus and the capability of the LR specialist. If the campus level LRC is to function as a node in the real time activities of

a telecommunications network, considerable attention must be given to space and equipment requirements as well as to increasing staffing and re-training existing staff, many of whom were educated before the current emphasis on electronic technologies.

Storage of learning/instructional materials for easy access by users at the campus level often becomes difficult because of constraints of floorspace for new materials, of limited availability of specialized shelving and packaging designed for non-book media, of frequently overprotective staff attitudes, and of genuine concern for security of the physical items, especially equipment.

Maintenance is also a major problem at the campus level unless the district or service center provides regular maintenance service and personnel. Few districts currently have funds to allow each campus LRC to maintain service contracts for equipment and for checking and repair of software. Specialized personnel who can maintain and routinely check electronic equipment are especially critical, since many present staff members have learned of necessity to deal with electro-mechanical equipment but are terrified of the electronic.

A concern related to distribution is that of production at the service center, district, or campus level. If a telecommunications system is provided to distribute software for students to use as well as to distribute information for teachers and administrators, to provide in-service education, and to assist in decision-making, it may still be necessary to produce some materials locally in-house. In addition, the possibility of distribution of well-prepared materials via a network from the campus or classroom level to other personnel at the district, regional, or state level must be considered. If such two-way distribution is undertaken, the proprietary rights of the designers and producers of materials at the campus level must also be considered. Decisions must be made as to who owns the copyright and whether it is legal for an individual to copyright materials prepared in a campus LRC using LRC materials and staff.

Because of the ease of electronic duplication and the possibility of using audio and video to record materials distributed via a telecommunications system, even remotely at off hours, requirements for duplication equipment at the campus, district, and service center levels must be established. Copyright controls on duplication, particularly of audio, at the campus level must also be instituted.

Evaluation and Selection

Use of a telecommunications system provides for interesting possibilities in two-way communication during the evaluation and selection process for all learning/instructional materials. Campus level personnel often have neither time nor access to many materials which they might wish to examine. A telecommunications system provides possibilities for remote preview of materials and for storage of data from users of materials, including such information as characteristics of learners with whom the materials have worked well, community and demographic characteristics of schools in which the materials have or have not been effective, cost data, and more thorough evaluative information than is commonly provided by the reviewing media.

Since the current state of bibliographic control of learning/instructional materials in anything but book format is extremely haphazard, could a telecommunications system fill some of the existing gaps? It appears that a statewide system could help with the gaps, but that the problem of bibliographic control is national, perhaps even international, in scope and that a statewide system could only function as a sort of band-aid. Until producers of materials are willing to provide complete information about their products upon release to a central listing source, even the first level of bibliographic control is circumvented. The NICEM Indexes provide this level for the items produced by many companies, but they are neither inclusive nor complete.

A second level of bibliographic control, that of indexing reviews, has only within the last five years become a reality with Media Review Digest, which has had to depend upon voluntary indexers who included only the journals which they had readily available. The new Bowker International Index to Multi-Media Reviews may help to alleviate this problem eventually, but it is feared that it will only compound the problem of producers not realizing the critical importance of getting their products reviewed.

A third level of bibliographic control, and the one most crucial to the current study, is that of the review and evaluation of items in the review literature. Producers generally are not consistent about the items that they send to the reviewing journals, and some producers do not provide review copies at all. Since the entire audiovisual industry grew up with a marketing orientation rather than a bibliographic control/review/evaluation orientation, many producers still do not see the critical need for their products to be reviewed in the bibliographic tools to which campus and district level LRC personnel have access.

A final level of bibliographic control, that of complete retrieval information that will provide multiple access points to materials, traditionally has been left up to the campus level LR specialist in cataloging or has been touched upon by service center media catalogs. A telecommunications system provides the possibility of an in-depth retrieval system for bibliographic and subject analysis and remote production of catalog information. This might best be accomplished through affiliation with an already existing network such as the Ohio College Library Center (provided OCLC incorporates media) or through a statewide system for media, depending upon OCLC, MARC, BIBNET, or other systems for similar information on print materials. A major contribution to this level of bibliographic control appears possible through a telecommunications system, reflecting the recommendations made in the Instructional Resources System study and proposals.

EMERGING TRENDS THAT SHOULD BE MONITORED

From the foregoing discussion, it is obvious that many recent developments are still in the process of rapid change and that statements made in this chapter may quite possibly be outdated before this report gets into print. Several trends which bear rather careful watching are highlighted in the following paragraphs.

Consortia for Production

Already a reality in the educational and public broadcasting field, production consortia may continue to develop as funding for production of really high quality software becomes more and more difficult. This trend should be monitored especially closely in the area of computer-based education, where the initial costs are so high and the shelf life of programs is less than three years.

Purchase Includes Duplication Rights

As indicated in the copyright discussion, stipulation of purchase with permission to copy may be the only way in which producers of certain types of materials, which are easily duplicated electronically, can survive. At the state level, special attention should be paid to the breadth of the duplication rights; for example, would it be possible for the Education Agency on a state basis to purchase one copy of an item for duplication and supply all campuses who desire the item from that one copy? If so, what are the implications for duplication facilities? Can the networking principle be applied, or does networking automatically negate the permission to copy implied in purchase?

On-Demand Publishing

Little has been mentioned publicly about on-demand publishing but the possibility of it becomes more and more likely as more publishers turn to data banks of their products as the source for their actual editing and publication. Will it be possible in the future, for example, to order a collection of items printed remotely, from the publishers data bank, tailoring the selection specifically to the intended user? Such a capability would be invaluable for in-service education, for updating information supplied to administrators and teachers, and possibly even for textbooks. Will the time come when, instead of adopting textbooks in hard copy versions, the state adopts textbook publication data banks from which unique, consumable textbooks are printed for each pupil, so that if Johnny requires third grade content in addition and subtraction, 2.5 content in multiplication, 2.0 content in fractions, and 1.2 content in theory, and arithmetic book can be prepared specifically for his needs?

Standardized Validation Practices

Work of the National Learner Verification and Revision Task Force, of EPIE, of the Society for Learning Technology and of other groups concerned with evaluation and validation should be monitored in the area of validation practices. The examples set by the Air Force in its Advanced Instructional System may be examined for viable processes.

State Adoption Program

As consideration is given to change in the formats of learning/instructional materials provided under the textbook adoption program, both in the proposed revision of the state constitution and in the implementation of the Instructional Resources System through legislation or action of the State Board of Education, the effects of such changes in providing software for use in a telecommunications system should be considered. Since software is, essentially, an inter-related system comprising textbooks, items provided by the district, and items provided through Education Service Centers, the introduction of telecommunications and its associated software as a part of the total software system will require monitoring and possible reassessment.

Copyright

Because of the crucial role of copyright in any software distribution and storage system, constant contact should be maintained with the Educational Media Producers Council, NEA, American Publishers' Association, American Library Association, AECT, and other organizations which are lobbying about and immediately concerned with copyright legislation. Continuing contact with large producers might also prove beneficial, as they seek laboratories in which to experiment with new modes of distribution which protect the proprietary interests of the producer but also make materials readily available to the consumer at affordable prices.

Although it would be foolish to state that the success or failure of a telecommunications system hinges on the quality and availability of software, it should be noted that the finest possible system for transmission is uneconomical without adequate means for generating, acquiring, indexing, retrieving, and accessing already prepared content. Until some of the software problems are solved, only limited usefulness can be expected from a statewide distribution system.

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VIII

PRÉCIS

This rather speculative portion of the report begins with a brief examination of social, political, economic, and technological factors, all of which have separate import for the future.

The next portion looks ahead with regard to the technologies involving transmission of information, and includes trends and forecasts in the areas of bandwidth; coaxial cable; quality of data rate, accuracy, and reliability; telephony; satellite transmission; radio broadcast; and cable television. Each of these areas is examined in terms of its educational possibilities, and the resulting forecasts comprise necessary considerations. Cable television has quite a promising future, as seen here.

This section is followed by another that treats educational display technology and devices in much the same way. Included are computers, interactive television, dual channel broadcasting, video projection, video playback, laser holography, picturephone, dial access, libraries and learning resource centers, and home learning centers. These discussions point out the strong likelihood that the home learning center will come into popular use, and the need for compatibility between this technology and those in use in schools.

The chapter narrative concludes with a description of a hypothetical, optimal educational methodology, but with the mental reservation that what is optimal today may be obsolete tomorrow. The emphasis remains on systems which not only instruct but also store, retrieve, manage, and counsel.

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VIII

FUTURES IN TECHNOLOGY

GENERAL

The Future in Education 1980-1990

Any forecast of the educational future for the period 1980-1990 would be meaningless unless it included consideration of the following areas: (1) social; (2) political; (3) economic; and (4) technological. Placing these factors in order of importance, the technological factors would have the lowest priority and the social and political factors the highest, with the economic factors falling somewhere in between. A discussion of each type of factor follows.

Social Factors

In the United States prior to 1950, the general attitude toward education was simply that a student would finish elementary and secondary school and, if interested, go on to college studies intended to prepare the individual for making a living. For those who did not wish to attend college, the vocational track in high school served to provide both training and opportunity for employment. It is important to note that the traditional emphasis in education was placed on the student's absorption of a tremendous amount of content matter from a vast number of textbooks. "Learning" was thus accomplished through rote methods of recitation, repetition, and, at examination time, regurgitation of the material covered.

Today, there is an increasing use of technology-based systems that involve not only production but services as well. Such systems require that the average person have at least a minimal knowledge of science and technology, and the starting point for providing this knowledge is through education at all levels, from kindergarten to adult. Furthermore, for individuals to live in a responsible society and clean environment, they must learn about the environment, its ecology, its energy needs, and its system of interrelationships. Some of the major problems now facing us and affecting our future survival involve complex physical, biological, and social systems and human interaction with these systems. Solution of these problems requires a public educational system of the highest quality: one which does not allow the existing educational system to deteriorate but which provides longer range programs which reach a higher proportion of the population. Elementary and secondary school programs must incorporate a "hands on" approach designed to cope with the real life problems of the majority of students, and must be oriented to the practical rather than the wholly theoretical. Wherever possible, the individual must be freed from "lock step" rote learning of factual matter, and instead be allowed to pursue an open-ended, interdisciplinary learning course that will involve judgments, values, and decision-making at the appropriate points in instruction.

Since 1950, the emphasis in American education has indeed veered away from content matter and focused on the individual's formulation of values and value judgments through decision-making. This change has, in turn, upset the traditional idea that an individual's education is complete at graduation; the learning process is now viewed as a lifelong one, involving persons from four to ninety years of age through use of a wide variety of techniques and applications. Toffler (1974) describes the future social implications of education as follows:

> ...the combination of action-learning with academic work, and both of these with a future orientation, creates a powerfully motivating and powerfully personal learning situation. It helps close the gap between change occurring "out there" and change occurring within the individual, so that learners no longer regard the world as divorced from themselves and themselves as immune to (and perhaps incapable of) change. In a turbulent, high-change environment, it is only through the development of a "psychology of the future" that education can come to terms with learning.

Political and Economic Factors

Granting eighteen-year-olds the right to vote in 1972 has had a significant impact upon national legislation. The federal government is now placing more emphasis on pollution and ecology, as well as on bilingual education and other educational opportunities for minority group members, because of the spirited efforts of young people and other organized groups (e.g., "Nader's Raiders"). Legislation deriving from the various political aspects of these issues has, in turn, had a great impact upon the economic situation of the United States. A case in point, relating to the growing environmental concern described above, involves the noxious pollutants emitted by automobile engines. Starting in 1970, car manufacturers were required by federal law to fit new models with various anti-pollution devices, which did reduce the emission of harmful substances but also reduced gasoline mileage. When the nations of the Middle East declared an oil embargo in 1974, the resultant economic impact with regard to energy requirements was so great that the President and Congress of the United States took steps to initiate a program called Project Independence. This program was designed to speed up research in solar, geothermal, and nuclear energy. Thus, political retaliation against the United States government by a group of other nations has re-directed attention, even if circuitously, to the original issue of environmental cleanliness. This issue has also resulted in increased awareness and increased educational emphasis, manifested not only in the development of courses relating ecology and pollution to socioeconomic issues but also in the amount of energy research now being undertaken by educational institutions.

Technological Factors

With emphasis shifted to the learner rather than the teacher, education will focus more sharply on the availability and dissemination of information, whether through automated data banks or through rapid access teleprocessing systems located at information storage centers. As more options for student learning become available, the costs associated with such advanced systems are anticipated to increase the costs of education on a per capita basis. No longer will there be a division between the classroom and the home; rather, students will carry with them their electronic books and from their homes will access utility-based computer facilities for a continuation of their individualized instructional programs. A greater degree of flexibility will allow the students to study as early or as late as they wish to. The technology most instrumental in establishing this futuristic educational system will probably comprise fast, efficient, and tiny portable communications devices with discrete addresses for locating pages and for communicating with individuals on a switched basis via a combination of satellite and land-based networks.

However, predicting trends in communications technology is a difficult task; not so much because of the complexity of the processes involved, but because of the uncertainty as to when a particular innovation will be adopted for use. A case in point is the Bell Telephone Laboratories Picturephone Project, which has been under development for well over 20 years. The system, running between Pittsburgh and Chicago, was originally designed to operate in monochrome. It was improved in 1960 to operate in color and was re-designed to use a "six-wire" automated electronic switching system. Factors responsible for the eventual decision to suspend the project included the high plant costs involved in setting up a nationwide picturephone switching system and the uncertainty or lack of public acceptance. These costs were simply too high in relation to the benefits that might be derived from one caller being able to observe another while communicating. It was also found that the very same results could be obtained more economically using 4 KHz voice bandwidth circuits with slow-scan video techniques. With the latter, the image changes once every 15 or 30 seconds at a cost of about one-fourth that of the picturephone wideband circuit. Such transmission, however, appeared static or lifeless to the viewer and therefore had an even lower user acceptance. Finally, the decision was made by Bell Laboratories to cancel the entire project. The point here is that while a continued flow of innovative ideas and new devices is vital to any sort of progress, such ideas and devices are worthless if they do not from the outset consider realistic social, economic, and educational telecommunications needs.

In the final analysis, it has been proved more practical to use a standard commercial wideband television channel on a leased basis with commonly supported equipment than to use the specialized picturephone system. But it is the factor of acceptance that is still a matter of uncertainty. Telecommunications technology today has progressed so far as to have outstripped user applications and acceptance in many ways. For example, the number of telecommunications techniques that the National Advisory Space Authority (NASA) has developed in systems for putting astronauts on the moon may be cited. Real time telemetry signals are used for monitoring the astronauts' vital functions, such as heart beat, respiration, temperature, and blood pressure. Such complex real time on-line monitoring systems are currently widely used only in the fields of space and medical research, although many schools and colleges are now beginning to adapt these as teaching techniques for laboratory monitoring of experiments, data acquisition, and data analysis. Further, some of the newer building maintenance systems are using on-line computerized real time recording systems which adapt telemetry and multiplexing techniques for keeping records of temperature, humidity, heat regulation, air conditioning, exits and entrances, security of door locks, etc., but this is a specialized and expensive exception rather than a common everyday application. As far as costs go, such systems are well beyond the budget of the average homeowner. They may in the future be widely used in individual or multiunit residences, but only when cost and consumer acceptance factors make them as desirable as they are already technologically sound.

A positive example of steadily increasing use of a new technology can be seen in the development of pocket calculators, which when first marketed in early 1972 were in the range of $100 and up. These same calculators are now selling for less than $20, and are being purchased by secondary school students for use in mathematics. Factors of low cost production technology, consumer acceptance, and ease of use have merged to spell market success for the pocket calculator. Unfortunately, the same does not hold true at present for the various educational applications of telecommunications, because of the number of complex factors involved which must be analyzed by the school architect, the administrator, the parent, and the teacher in order for future structuring of technology-based systems in education to take place. It is extremely difficult to identify and define the future needs of education taking into consideration both the existing socioeconomic problems in public school systems and the dynamic, continually changing state of educational technology. Thus, instead of ready acceptance of new systems, we have a wide divergence of educator opinion on what is really effective in bringing about improved teaching and increased learning. The vast broadening of options now available to teachers runs the gamut from self-programming teaching texts to sophisticated computer-managed teaching systems, but few if any of these new technologies are currently being integrated into teacher training programs. In addition, the training of skilled specialists in the field of educational technology is also limited to a relatively small number of institutions. Many of the new systems have not been proven cost-beneficial by a thorough economic analysis that is based on fact and not supposition.

The transition of innovative educational ideas from feasibility to economic practicality and their subsequent integration into existing curricula is not a simple task. Individualized education, for example,"the Keller method," is a new concept in instruction, and one on which much more research is needed before we can determine its true role and importance. With regard to the application of telecommunications to education, by far the greatest impact has been made by the use of wideband (4-6 MHz) channels for video broadcast systems. In fact, the dissemination of information, instructional materials, news, and similar "video-cast" matter constitutes but a small part of the total applications predicted to be widespread by 1980. Baran (1973) describes at least 30 different "interactive TV" applications, falling into the categories of news, entertainment, business, health, government, banking, education, and electronic mail, of which the largest percentage (21 percent) of the total are educational. While many of the applications require man/machine real time interaction or dialogue, some are merely "automated closed loop TV systems" which can be activated without the presence of a human. (A more appropriate term here would be "two-way TV channel services.")

In the remaining portion of this chapter, the new telecommunications technologies will be summarized, along with their possible impact upon the future of education. A dichotomy exists here in that the technology itself can be described in terms of the state of the art, whereas discussion of its specific educational applications must delve more deeply into the actual instructional implementation of the learning process. An example of such dichotomy is the overall technology of satellite systems as compared with the use of these systems for two-way teleconferencing of in-service teacher training programs; both aspects will be covered in dealing with each discrete technology.

TRANSMISSION OR CARRIER TECHNOLOGIES

Bandwidth

Prior to World War II, commercial communications systems were primarily landline engineered systems composed of open wire or lead cable with quadded groupings. The bandwidth normally employed 300-3400 Hz for single channel voice frequency transmission, with further expansion of channel capacity through the use of carrier telephone groupings for long distance calls. After World War II, microwave radio systems were installed in a nationwide system through the use of towers on a point to point (line of sight) linkage, with the towers fifteen miles apart and regenerative repeater systems in between them to boost the signal to its original transmission level. Because the wider bandwidth was available for transmission, each microwave chain could carry up to 11,000 individual telephone (voice) channels, or in wideband transmission 12 television channels.

The state of the art with regard to microwave finds it still improving in expansion of channel carrying capacity. Microwave systems have had the greatest impact upon education as a delivery system, since 90 percent of all educational television programs are carried by commercial broadcast television stations. Since these systems operate at a very high frequency (80 to 150 MHz), their potential for expansion in yet higher frequency spectra is excellent. Experimental systems are being tested using a circular (helical) wave guide in the frequency range of 100,000 MHz and containing 200,000 telephone channels for use in a single system. (The conversion ratio from a voice channel--4 KHz--to a television channel--6 MHz--is on an approximately 1200 to 1 ratio.)

The advantages of the helical wave guide systems are that (1) they have an extremely low noise level; (2) they are very easy to adapt for use in transmission of digital data through pulse code modulation techniques; and (3) they have a high capacity for addition of channels. Table VIII-a indicates the development of such systems from the twisted pair (cable) to the laser, the latest experimental transmission medium with an extremeely wide bandwidth. The laser, which operates in the frequency range of light, has already been used in the NASA space program in transmissions to earth from manned space vehicles on the moon. While laser communications are still in the experimental stage for use on earth, they will play a very important part in communications systems of the 1980's. Lasers will be as revolutionary in future educational telecommunications systems as radio was in the systems of the past.

VARIOUS TRANSMISSION SYSTEMS		
System	Average Number of Channels	Application
Open wire	12	Telegraphy, voice
Twisted pair cable	1,200	Voice, data, facsimile
Submarine cable*	720	Voice, data, facsimile
High frequency radio	24	Voice, data, facsimile
Coaxial cable*	600	Voice, data, video, facsimile
Microwave**	1,800	Voice, data, video, facsimile
Ionospheric scatter	96	Voice, data, video, facsimile
Tropospheric scatter	1,200	Voice, data, video, facsimile
Mobile radio	1,000	Voice, data
Helical waveguides***	100,000	Voice, data, video, facsimile
Satellite systems***	100,000	Voice, data, video, facsimile
Laser systems***	1,000,000+	Voice, data, video, facsimile

*1950
**1960
***1980 (estimate)

Table VIII-a

The laser (the word is actually an acronym for Light Amplification by Stimulated Emission of Radiation) was preceded by the maser (Microwave Amplification by Stimulated Emission of Radiation). The advantage of laser beam transmission is that it is carried out over a very narrow (1°) beam of light monochromatically in a coherent manner which ensures uniform arrival. A laser telecommunications system does require a precisely controlled beam of great intensity and amplification. However, the frequency of a laser beam is 100,000 times higher than that of today's commercial microwave system, and the potential for expanding the transmission bandwidth of a laser system is also 100,000 times greater. Laser systems of the future are still highly experimental; the major problem still to be solved is the development of an efficient technique or methodology for superimposing and modulating information onto the "beam" itself. Currently, the rotating and scanned prism/mirror method is the technique most commonly used, with transmission rates of up to a billion Hz per second. One offshoot of laser technology is the commercial application of a laser beam printing system, which is already on the market. The International Business Machine Corporation (IBM) has announced a laser beam (computer) printer that costs over $300,000 and prints at the rate of 4,000 lines per minute. ("IBM's New Printer Uses Laser," Electro-Optical Systems Design, 1975) The Cannon Company of Japan has also built a commercial laser beam printer called the model 1000 LBP, which prints computer outputs on coated sheets of 8½" x 11" bond paper in black and white at the rate of 2,000 to 4,000 lines a minute for alpha-numerics and/or graphics. A further application of the use of laser beam technology is in closed types of communication systems using fibre optics for the "transmission pipe." Research is still continuing in this area.

In summary, bandwidth for transmission of information has always been a problem in communications. With the advent of laser beam systems, many of the problems associated with bandwidth, portability, and frequency allocation can be alleviated. Educators in future years may avail themselves of small, inexpensive, portable laser-type communications terminals for communication with a computer via an educational satellite. Such a system could be operated by an agency of the federal government; this possibility is but one of many that a consortium headed by H. Rex Lee, former commissioner of the Federal Communications Commission, and a panel of educators and scientists are considering for a future U. S. satellite system as a follow-on to the NASA ATS-6 system, now in India.

The Aloha Project at the University of Hawaii is also investigating the use of portable satellite ground terminals of all types for communication from remote areas to a satellite and linkage to a computer interactively. This educational application, although it has been quite costly during initial tests, may yet prove to be the key for schools or students in isolated areas, since the electrical path is not restricted to a fixed geographic point. Each terminal would be mobile and would use small, low-cost, portable equipment. This technology is also discussed in Chapter VI under "Satellite Telecommunications."

Coaxial Cable

The use of coaxial cable for wideband transmission and reception of television channels in cities and small, outlying towns is now nationwide. Many small private companies operate community antenna television (CATV) service in areas where the terrain is so rugged that television reception is possible only from high mountaintops or through extremely high antenna towers. Most systems are linked at the source either to a microwave (header) system or to an interstate commercial coaxial cable system. Newer coaxial cable systems carry as many as 3,600 voice channels in one cable. Normally there are 20 or more individual cables in a bundle, with two of the group being spare (emergency) cables. The remaining 18 cables can carry up to 32,400 two-way voice conversations or 20 TV channels. In some instances, remote broadcast lines from the studio to the transmitter site are handled via special coaxial cables where the distance is fairly short. Where longer distances are involved, microwave links are used for transmission. Improvements in coaxial cable have been (1) the development of cables which are smaller in diameter and (2) increased channel capacity as a result of improved engineering design. In future coaxial cable distribution systems, two-way coaxial cable will play an important part both in interactive television and in home computer terminals for interacting with a computer in a time-sharing mode.

Functions of Data Rates, Accuracy, and Reliability

In the foregoing section, channel capacities and bandwidths for the various types of systems were discussed. In this section transmission rates, accuracy of data transmission and system reliability will be discussed. These considerations apply to a wide variety of systems, but are most commonly related to computers.

System quality and data transmission rates. Most information other than voice is transmitted in a message format, using a character mode in coded form. The number of binary digits (bits) per character also has an important bearing on the speed of transmission in one of the two general kinds of transmission, "serial," wherein the bits comprising characters are sent out on the line one after another. The other type of transmission is termed "parallel"; in this type, bits of a character (or word) are sent simultaneously over as many lines as there are bits to be sent.

Parallel transmission is normally used within computers and in scientific applications where extremely high speed is paramount. In parallel transmission, obviously more lines are needed, and the expense is proportionately higher.

Data transmission in most current systems, however, is via serial transmission. Since words usually move in parallel inside computers, it is usually required that the system have at some point just before the transmission medium a "buffer" or other similar device to hold some number of bits received in parallel and to serialize them, or perform parallel-to-serial conversion. Serial-to-parallel conversion must be accomplished at the receiving end of the line.

The speed with which bits can be sent down a line is called the "bit-rate" on the line (often the term BAUD rate is used interchangeably with bit-rate), and is directly related to another characteristic of the line--bandwidth. As bandwidth increases, so do the speed of transmission and the number of bits--and so does the cost of the line through fixed tariff rates.

The process of impressing intelligence upon a line or channel is called modulation. Many types of modulation are available to transmission engineers and most are applicable to data transmission. Some of the more common types are:

(1) Amplitude modulation--wherein the "carrier wave," or standard reference signal which is present on the line at all times, is varied in direct proportion to the amplitude (strength) of the signal being impressed;

(2) Frequency modulation--wherein the variations in amplitude of the intelligence (or modulating) signal are used to vary the frequency (measured in cycles per second) of the carrier wave;

(3) Phase modulation--wherein the phase of the carrier wave (amplitude on a time base) is shifted ahead of or behind normal in accordance with the intelligence pattern of the modulating signal;

(4) Pulse time modulation--wherein values of samples of the modulating signal are used to vary the time of occurrence of some characteristic of the carrier.

Other common types of modulation are pulse amplitude modulation, pulse duration modulation, pulse position modulation, and pulse code modulation. The most promising technique for future use is pulse code modulation (PCM), which is a data sampling technique in which human speech (or data) is translated into "time slices" of binary code and each sample is transmitted over telephone lines and reconstructed at the receiving end. The advantage of PCM is that it virtually eliminates any background noice that may be present, thus producing a very efficient type of transmission system.

Since the process of impressing intelligence upon a line--or modulation--must be performed at the sending end of the line, it follows that demodulation--the process of extracting intelligence from the line--must be carried out at the receiving end. A common example of this procedure occurs in normal AM radio, wherein intelligence (voice, music, etc.) generated at the studio is imposed upon a carrier wave (the frequency of the transmitter), and the carrier wave is used to transport the intelligence to the individual s house or car, where his/her own radio receiver is then used to de-modulate the carrier wave and reproduce the intelligence.

As it is with radio, so it is with data transmission. The device used to accomplish the purpose is known generically as a modem or modulator-demodulator. Many types of modem are used, and they are sometimes called by different names. The most common of these, used by telephone companies, is a "data set."

Other terms used in describing specific kinds of modems are "synchronous" and its converse "asynchronous." In the context of data communications, to say that a modem is synchronous is to say that the sending modem emits intelligence into the line at a rate determined by itself rather than by some other device. The receiving station is in synchronization with the transmitting station. An asynchronous modem gets its signals for emitting intelligence from the device which it connects to the line, e.g., a computer terminal, a magnetic tape transport, or a punched paper tape transmitter, and processes the information as it is received through its internally set data rate.

The major function of a modem is to connect devices such as a computer to a line. Other functions are performed as well; these are:

(1) Switching from voice use to data use;

(2) Dialing up on telephone lines;

(3) Providing a telephone unit for voice communications.

Not all modems perform all of the above functions; therefore, it is important to consult directly with the organization furnishing the equipment to determine its specific capabilities. It should be pointed out that in the case of leased lines using a commercial dial (or touchtone) telephone for data use, modems are normally furnished by the common carrier (AT&T, Bell, Western Union, etc.). In the case of private (leased) lines, modems are normally provided by the user leasing the line facility.

Transmission of data can be accomplished through three types of line use:

(1) Simplex--one-way only transmission (as in a case where the sending end has only a keyboard or other transmitter and the receiving end has, for example, only a printer);

(2) Half duplex--transmission can go either way, but only one way at a time;

(3) Full duplex--two-way simultaneous transmission.

In summary, it can be stated that the wider the bandwidth the greater the amount of data that can be transmitted over a line and the faster that data can be transmitted. Video (television) signals require the greatest amount of bandwidth and data of all of the types of signals transmitted. Two-way (full duplex) high speed digital data that are transmitted at rates above 2,400 bits per second normally use a four-wire line (send and receive) with synchronous modems and conditioned (electronically balanced) circuits.

Telephony Systems

Most existing common carrier communications systems were engineered over 50 years ago and are of the analog type designed to carry voice transmission. (Data transmissions of binary signals did not start commercially until 1958.) Exceptions to this rule are the newer common carrier systems, which are purely digital in their engineering design for transmission; however, digital systems comprise less than two percent of the 360 million miles of commercial long distance communications in the United States. The prevalent analog systems have one basic fault: noise that is generated within the system between one or more points linked together builds up; thus, the longer the transmission distance the greater the total amount of noise accumulated and transmitted. The Bell System takes this factor into account, and sets some rigid standards for both transmit levels (zero db.) and receive levels (-16 db.). When the signal drops below -16 db. level, it is regenerated and amplified up to its initial level for transmission to the next portion of its destination. Voice telephone utilizes a channel (or circuit) with a bandwidth of from 300 Hz to 3,400 Hz, which is adequate for voice recognition and transmission. Unfortunately, when data from computers or computer terminal devices are used with voice (analog) channels, the signal to noise ratio of the data pulses in poorer quality channels may be marginal and thus the noise itself may cause many errors to be introduced in the transmission of printed characters. Since digital data can be transmitted at rates varying from ten characters per second to over one million characters per second, existing analog type communications channels are technically inadequate to handle the higher rates. There are many reasons for this, the primary ones being system obsolescence and the inadequacy of present engineering design standards to cope with more stringent new standards in data transmission. The Bell Telephone Company has been involved in a major system upgrading and conversion effort since 1963, to improve the system to meet the new data standards, and has undertaken (1) the installation of electronic solid state telephone switching centers (ESS); (2) the installation of new microwave and coaxial cable systems; and (3) the engineering and installation of true digital data switching systems called the T-1, T-2, and T-3 systems, which are designed to handle digital data at speeds up to a million bits per second.

Future plans by the American Telephone and Telegraph Company, parent of the Bell Telephone Company, for telecommunications network improvements over the 360 million circuit miles of its system call for the installation of advanced underground coaxial cable systems using "L5" coaxial cable. This wideband transmission cable can provide an efficient type of amplitude modulation in which one of the two available sidebands (the signal-containing bands on either side of a carrier frequency) is transmitted; it utilizes from approximately 1.6 MHz to 69 MHz of the frequency spectrum. A typical configuration would consist of a 22-tube underground cable system which could provide and carry some 108,000 simultaneous telephone calls. Routes from Pittsburgh west to Chicago and east to New York City are now undergoing conversion, and should be ready by the end of 1975. This expansion will then be continued on a nationwide basis, and should be completed by 1977. One major advantage of this system is that it will also provide high speed digital data service operating at 6.312 megabits. Essentially, the major part of this subsystem will handle a private data transmission service designed for multi-station use and designated as the T-1 through T-5 carrier system.

System accuracy. One of the important features of the new Bell digital data systems will be a built-in error detection and control technique which operates through the use of either an odd or an even parity count of the blocks of data received at the end of each transmission. If there are errors in data transmission, a built-in system feature automatically causes the data (or information) to be retransmitted.

Some systems insert special filler groups of formatted data blocks called "Hamming codes," which function in essentially the same manner if errors are detected. There are also many other types of error detection and correction methods, e.g., longitudinal redundancy check (LRC), which will not be described here for the sake of brevity.

System reliability. As newer common carrier communications systems are built to more rigid and demanding engineered system standards, a new high in system reliability can be anticipated. One of the major features of such systems will be a system reliability of 99.9 percent, barring unforeseen acts of nature or of man. To cope with such unforeseen contingencies, system redundancy has been built in and includes fail-safe features such as (1) emergency back-up power, (2) parallel operating units, (3) automatic reroute in case of failure, and (4) automatic testing *during* actual system operation. All of these features were lacking in earlier systems.

The problem we face with the continuing improvement of systems and technologies is that the systems rapidly become obsolete, because the dynamic state of research results in increasingly shortened periods for planned usage; thus as we step up to the next plateau of sophistication we also increase our costs proportionately.

Future trends. Looking even further to the future in telephony, Bell Laboratories has recently built an experimental prototype which can be used as a video display terminal, an alpha-numeric data entry device, a facsimile transmitter/receiver, an automatic dialer, a calculator, a clock, and a calendar. The unit was developed to assist with research on man/machine interaction, and Bell has no immediate plans to offer it to customers.

Within the experimental telephone is an eight by four inch plasma panel which comprises thousands of neon gas cells (60 cells per inch) arranged in rows. Application of an electric current can cause any one of the minute cells to glow, thus allowing for the creation of alpha-numeric and graphic images. A light pen is also connected with the unit and can be used to select a point or item on the panel and transmit the information via telephone to a computer or to another telephone. Potentially, the device can be used to:

- Display a typewriter keyboard, allowing hunt-and-peck data entry to a computer by pointing the light pen at letters and numbers.
- Record a person's signature and either transmit it to another unit or store it for recall on command.
- Reproduce pictures and charts.
- Display a list of telephone numbers and dial the one pointed to with the pen.
- Serve as a desk-top calculator.
- Display the time and date on command. ("Bell Unveils Experimental 'Super-phone,'" Minicomputer News, 1975)

In summary, existing telephone switched networks were designed in the 1920's and based upon the then current state of the art in (1) analog transmission techniques; (2) toll carrier telephony channel trunking; and (3) mechanical types of exchange switching systems, such as the Stroger and Crossbar exchanges using D.C. pulse dialing with two-wire transmission systems for subscribers. In the 1960's, AT&T introduced the touchtone telephone, with multi-tonal A.C. calling plus electronic solid state exchanges (ESS) using four-wire, full duplex automated switching via discrete addressing (area) codes. The subsequent integration of satellite links for overseas communications via COMSAT Corporation in 1965 introduced an entirely new technology into the existing system, with satellite ground stations interconnected to microwave and land coaxial cable systems for broadband, data, facsimile, and voice channels. Since then, in addition to AT&T and Bell Telephone, the following companies have entered into the common carrier field:

(1) DATRAN Corporation;

(2) Microwave Communications, Inc. (MCI);

(3) American Satellite Corporation;

(4) C.P.I. Microwave, Inc.;

(5) Western Union (Westrex) Telegraph Co.;

(6) Southern Pacific Communications Co.;

(7) RCA Global Communications.

At present there are over 180 independent telephone (common carrier) companies in the United States; however, Bell Telephone controls over 90 percent of the nation's telephone resources and business. While it is gratifying to note that the newer common carrier firms are providing the latest type of digital switching systems, using advanced pulse code modulation transmission techniques, they cover only toll points between larger cities and involve only two percent of the total resources. Thus they are of limited value to educational telecommunications, except for long haul video transmission from originating cities in the eastern part of the United States.

The future survival of these latecomers cannot be predicted. However, they are fiercely competitive, and offer much lower rates for data services than do American Telephone and Telegraph Company or Bell Telephone.

Future techniques using telephone will include man/machine direct communications with computers, e.g., voice digitalization for recognition of the spoken word, with printouts of dictated material. Other applications in this area involve voice (speech) recognition and analysis (voice fingerprint) on a digitalized basis for security access to restricted areas, e.g., banks, examination storage vaults, etc. Another significant use will be remote conferencing, which is now being tried experimentally in Great Britain to a limited extent by the Post Office in a system called CONFRAVISION. The use of computer terminals in the home to dial up computer-based libraries will also be commonplace in the 1980's, and computer technology will undoubtedly affect banking, newspapers, shopping, entertainment, and individualized instruction. Both the telephone and coaxial cable (CATV) systems will play an important part in the future once they are linked with satellite systems in an international network of real time systems.

Satellites

The American Television and Communications Corporation is currently offering the first commercial pay television programs to be presented via satellite relay. ("American Television to Offer Pay-TV Plan Provided via Satellite," The Wall Street Journal, 1975) This project is being conducted in Florida, where Home Box Office, Inc. is selling the program service to some 40,000 CATV subscribers. Special hardware which unscrambles the TV signal is attached to the homeowner's set, together with a metering system hooked to a central recording computer system. Linkage from satellite ground station to the CATV header system is through microwave. Basically, the system functions as a utility, with the user paying only for specific programs selected for viewing on various channels.

Such a system could conceivably be evolved for educational television if the economics of providing a profit motive for home self study could be worked out. Whether the system carries news, entertainment, or education, the delivery capabilities exist; the only constraints are the need for financing and the related need to provide a multi-purpose system, since the costs of a dedicated, wholly owned system would be prohibitive for school districts and other educational institutions.

Radio Broadcast

Radio broadcasting in 1980 and beyond will see radical changes, brought about through more efficient management and utilization of the radio frequency spectrum because of advances in laser communications systems. The present radio frequency spectrum allocations made by the FCC have resulted in overcrowding and are inadequate to meet some of the newer needs, such as land mobile services (fire, police, taxi, dispatching, and private subscriber) and mobile educational broadcast stations. Thus, it is very important that there be a complete reappraisal and analysis of future needs for frequency allocations. There will be a greater tendency in the future to use radio and television systems in closed type systems (multi-channel coaxial cable) rather than for commercial omni-directional radio frequency broadcast. Navigational systems for aircraft and marine vessels employing modulated laser beam communications will use satellite position-fixing reference systems rather than the present hyperbolic navigational direction-finding systems. People in remote areas of the world will have access to the resources of any other area through portable satellite ground stations with call capability via international satellites to computerized libraries, instructional materials, and medical services. (This concept of remote access ground terminals is now being tested in India by the U. S. Department of Health, Education, and Welfare, using the NASA ATS-F fixed position satellite.) Both transmitters and receivers will become minute, cheaper, and more powerful as microminiaturized integrated circuitry enters mass production.

Despite the increase in television broadcasting, which requires the viewer to observe the picture for full impact, the popularity of radio has not lessened because of the ease and practicality of using it in all sorts of situations--driving, walking, bicycling, etc. In education, however, its use is diminishing as video-stored types of materials become more common.

Cable Television

Jones (1973), in an article investigating the future impact of cable television, states that "two-way cable TV" will move into the home between now and 1980 in a wide variety of applications, including computerized teaching, entertainment, media presentations, newspapers, banking, and shopping. In fact, a prototype instructional system is actually being used today in a pilot project called TICCIT (Time-Shared Interactive Computer Controlled Interactive System), under the auspices of the MITRE Corporation, in the city of Reston, Virginia. (MITRE Corporation, 1974) Some 75 homes, each with a terminal, have been connected to a central computer site via coaxial cable. The TICCIT terminals are used not only for instructional applications but also for broadcasting of cultural material. No reports on findings or results of the Reston experiment have yet been published. However, Baran (1973) has predicted some 30 different effects on the life of the individual in the future because of ongoing refinements of two-way cable TV, as described earlier in this chapter.

The impact of two-way broadband communications on cable TV will be such that by 1980 approximately 50 percent of the residences and industries in non-rural areas are likely to be reached either by cable or by inexpensive satellite ground station interconnections. (Wall Street Journal, 1975) Two of the most widely used applications of the technology will be educational: (1) computer-aided instruction or tutoring adult education courses; and (2) access to information and reference materials via computer terminal. Other potential applications are too numerous to list in detail, but would range from electronic mail to legal and governmental administration. The capability of a wideband cable system to handle the total communications system requirements of an entire community has not yet been demonstrated on a full-scale basis, but the concept appears to have gained acceptance by communications researchers.

An important factor to consider in the future development of cable television systems is the existing legislation affecting them. In 1972, the FCC gave some 550 CATV systems five years to meet a number of requirements, which the present FCC Chairman, Richard Wiley, now feels are too stringent and too pressing and should be both postponed and reevaluated. Under the terms of the requirements, those CATV systems operating within the top 100 television markets had until 1977 to install two-way systems, so that persons receiving the programs could talk back to the sets in the manner of a closed-circuit TV classroom. Certain technological specifications were also imposed, and the systems were required to provide a minimum of 20 channels apiece, with a certain number of channels set aside for access by educators, governmental bodies, or the public. Wiley now states that while it is essential for cable television to continue to meet these demands with regard to access, it is imprudent to require the dedication of a number of channels which far exceeds the present demand. He also favors the payment of copyright fees by CATV owners and operators for materials used. ("Official Blasts CATV Law," Austin American Statesman, 1975)

EDUCATIONAL AND DISPLAY TECHNOLOGY AND DEVICES

Computer Technology

We are now in a period of dynamic change in computer technology and educational use of computers. Paradoxically, the prices of many computers are coming down while almost all other prices are going up. This decrease in hardware costs is encouraging, but it is only the tip of the educational iceberg, since the major cost associated with the use of computers is not that of the hardware but that of the great amount of software and courseware which will be required for extensive computer use in the school system. This issue has been discussed at some length in the previous chapter on software.

Much material, both highly technical and quite imaginative, has been written about the development of computers for educational use during the period 1980-1990. George Leonard (1968), in Education and Ecstasy, describes the role computers will play in the learning process in a school of the year 2001, through a fictional visit to the school by one set of parents to observe their offspring's progress. A panoramic view of the learning activities observed, as well as the school's overall educational philosophy, is presented below:

The learning structure depicted is completely dependent upon the computer and includes some extremely sophisticated display devices for terminals which are primarily graphics-oriented in nature. These devices have large tri-dimensional color pictures and sound as well as alpha-numerics in their repertoires.

The main area within the school is called the Basics Dome, which students may enter and leave freely, as the school has no schedules and the students are not required to attend classes at any specific time. Student ages vary from 3 to 10 years; after 10 years of age a student is expected to have learned all of the Basics programs, up to and including such subjects as calculus. The thrust of this kind of education is toward motivation to encourage completion of assignments by students rather than toward the coercion frequently found in more traditional learning environments. Leonard's views reflect an extension of the Keller plan or Proctorial System of Instruction (PSI) in use today in colleges, with the one exception being that there is no scheduling of any kind in the school Leonard projects. The course matter described is even more highly individualized than that presented via today's computer-managed instruction. The actual learning facility, the Basics Dome, is a circular environment with a ring of computer consoles around the outer wall. Each terminal has a keyboard allowing access to all types of exotic symbology, not just the standard typewriter symbols or APL, but a more sophisticated version of the PLATO plasma type permanent display. The student also has headphones available for audio messages, while the displays are actually a three-dimensional hologram in full color. All displays are adjacent to each other so that their edges touch, and the room has a continuous panorama of pictorial presentation which can be programmed on the computer in much the same manner as a complete diorama.

In adjacent or intermediate areas near the computer terminals are additional displays (resource learning areas) where the student can secure other instructional materials referenced in the original display. Each student is identified automatically to the computer by an electronic coded recognition device that can be used to sign on to the system by attaching the student's own discrete device to the computer terminal. The computer system contains all student records and all data on prior sessions, and usually starts a session with a brief review before moving on the new material that the student has requested. Individual sessions are not long--possibly 20-30 minutes--and sample sessions are described in Leonard's text. (The example given would be a very difficult type of program to carry out.)

In summary, the educational trend described leans heavily on graphics as a major form of media presentation, and the education of the future will inevitably be more graphics-oriented than is that of today. A forerunner of such a future system may be the present PLATO project at the University of Illinois, which uses plasma display terminals. Apparently, educators have come to regard the role of pictures as so important in the educational process at so many levels that vendors may plan the future design and development of terminal hardware upon a pictorial base, using reliable, low-cost display devices. Even such traditionally aural areas as language learning have evolved extensive computer programming with terminal displays, as evidenced not only on the university level (e.g., PLATO) but on the elementary and secondary level as well, with such programs as CARLOS (high school Spanish), developed at Dartmouth College, and the junior and senior high French Drill program in use in Lexington, Massachusetts (Hoye and Wang, 1973). The new video-based technology will employ such specific techniques as plasma display, laser beam holography, fiber optics, and liquid crystal displays. In the future large wall-sized displays will present verbal and graphic information, using one of the types of technology described or a combination of two or more.

Specific advances in the engineering design of many computers will probably include the following:

(1) Systems operation will be simplified, minimizing the necessity for operator training or for technical knowledge of the internal working of the system.

(2) "Intelligent" (self-contained memory) terminals will be designed which are programmed to guide the inexperienced user through various programming sequences via a simple set of instructions, with built-in stops when errors occur in format or in data handling. An example of prototypical terminals of this nature is the WANG Model 20 Hardwired Processor and Terminal Configuration.

(3) New input or peripheral devices will be developed which will allow the individual to communicate with the mini-computer in a simple manner. For example, such devices could involve voice-recognition by the computer of a limited or selected vocabulary (voice digitalization recognition); the words would have to be spoken in sequences separated from one another by at least 1½ seconds, with a separation of at least 1/10 second between individual words. One prototype of such a system has actually been developed by Threshold Technology, Inc., although at present only vocabularies of 100-150 words have been designed for it. The system, which utilizes a Data General Corporation Nova Model 1200 mini-computer, requires the speaker actually to train it by repeating each word at least 10 times in order for a recognition pattern to be developed.

(4) Micro-processors will be developed such as the Control Data Model 469 mini-computer, which is a cube of approximately 6" x 6" x 6". These newer, smaller versions of micro-computers use complete memory chips with circuitry of the LSI technology type, a layered, miniaturized circuitry that is so minute that a microscope is required to examine the discrete circuit elements. Each unit is packaged as an individual chip; such circuit "chips" are now sold as complete central processor units in the form of read-only memories (ROM's), programmable memories (PROM's), buffer and shift registers, counters, parallel and serial converters, plus all the necessary input-output features to store data and perform computations and the capability to communicate with larger computers in real time at high speed data rates if required.

(5) Low-cost (off-line) or permanent storage devices will be developed, such as the floppy disc or recently announced IBM discette storage systems, which may in time replace paper-punched systems, cassettes containing magnetic tape, and punch cards for the storage of data-based information or programs. More reliable plasma display panels (flat displays) with a higher degree of resolution will be designed to replace existing raster-scan-type cathode ray tube displays. These will provide a more reliable and stable (flickerless) terminal with a smaller space requirement than those of present terminals.

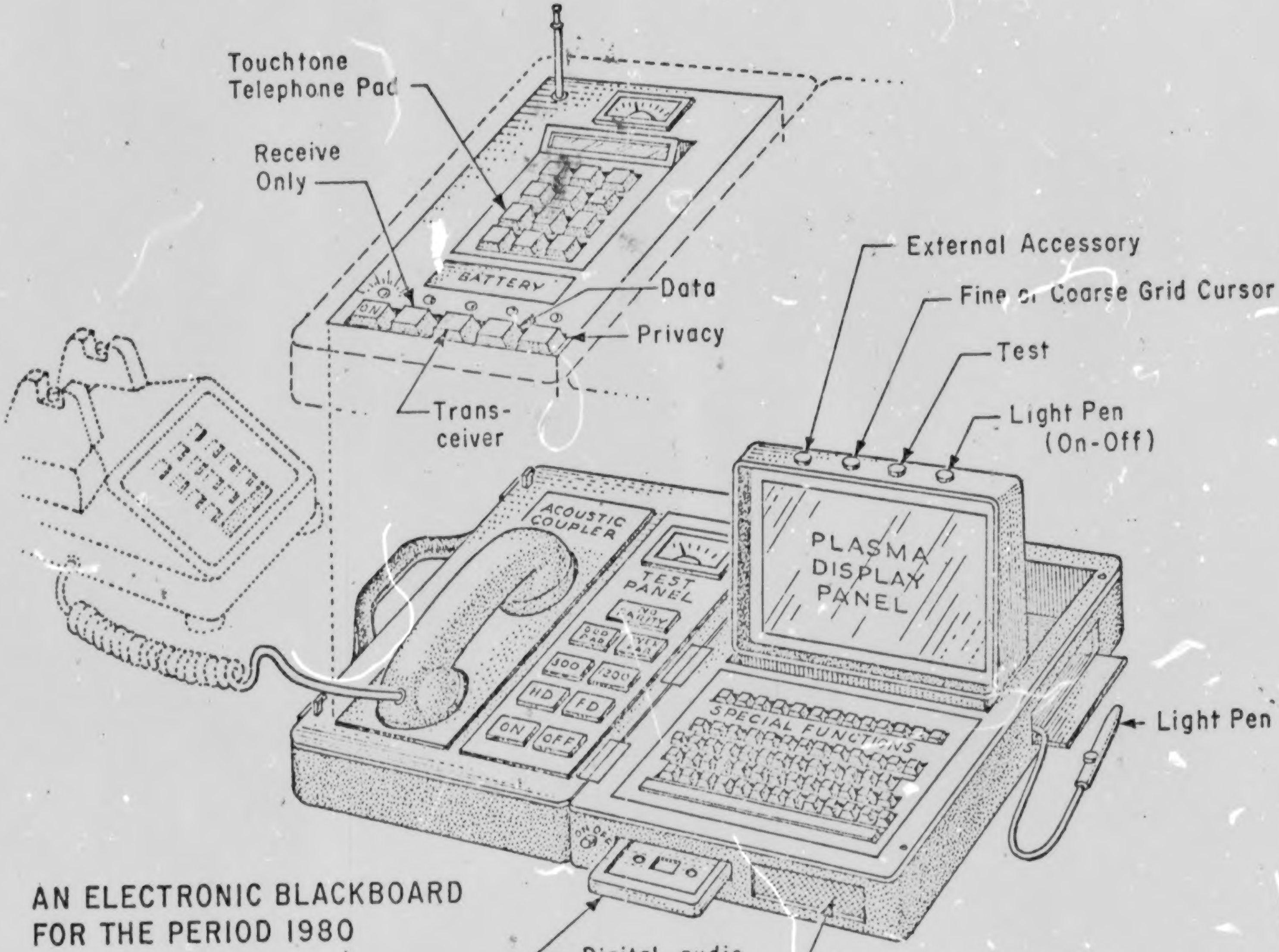
(6) The new systems will incorporate diagnostic and error-checking features which increase operational reliability and efficiency of maintenance procedures, and prevent unauthorized access to or changes in files through execution of repertoire commands that are virtually foolproof.

While George Leonard's description of the classroom of the 1980's, cited earlier in this section, may indicate a bit too much blue sky thinking on his part, some aspects of it are basically sound. For example, for the past six years, the Xerox Corporation, in its Palo Alto, California facility for educational research, has conducted experiments oriented toward the development of a portable computer terminal called the "Dynabook" for use by public school students by 1980. (American Federation of Information Processing Societies, 1975) The Dynabook as such presently exists only as a "test prototype" containing a plasma display and a light pen (no keyboard). The student uses the pen to select a menu of coursematter and also as a response device. While the unit is roughly one foot square and about four inches in depth, it was discovered that some problems existed with regard to the output capability of the power supply in relation to the desired miniaturized size and its compatibility with the rest of the unit. The Dynabook uses a programming language known as "small talk." Pilot testing of the unit in a real-life environment is underway in a nearby elementary school. The goals of the Dynabook project may be expressed more fully in a description of the following system specifications (which have been formulated hypothetically on the basis of the state of the art extrapolated for future needs). The terminal will operate as a color graphics plasma display device. It will be highly portable (weighing a maximum of 4 pounds), and in the shape of a book, with a resolution finer than that now available in graphics terminals of the vector generation type by one order of magnitude. The small terminal will have a computer memory of approximately 32,000 words and a speed of execution at least twice as fast as that of today's nanosecond operating mini-computers. It may operate in the picosecond range and will be able to compute complex problems as an independent system, using a completely new technology which will be developed by the time of its marketing. The terminal will contain a light pen and keyboard and will sell for less than $600. These stringent system specifications are presently beyond the state of the art for micro-processors. The current state of the art will, however, allow for miniaturization of the unit. The size of its memory and the resolution are not the major problems, however; the real problem is that present microminiaturization fabrication techniques still generate too much heat in proportion to the size of the circuitry, causing a decrease in the life span of the equipment. Presently there are no efficient microminiaturized power supplies available with more efficient cooling methods to keep the unit within the heat dissipation tolerances required for such a small, powerful, and compact terminal. Because of the power supply and heat generation problem, the life of the unit is relatively short when batteries are used in it. Therefore, new highpowered output/long-life batteries will have to be developed or new energy sources explored before development of such units can become cost-effective. Research is continuing on this project.

To depict visually what a terminal of this type would look like, a similar terminal has been conceptualized in hypothetical terms, with the features discussed above. This rough conceptualization appears as Figure VIII-A. While the description of the terminal for the year 2001 may be somewhat far-fetched, it is conpletely within the realm of technical possibility. It is also possible to provide an electronic book that will allow the student to use the portable terminal in his/her home, linked through telecommunications, or in the school, either independently or linked to a satellite if the school is in a remote area, at a cost of $600 or less. Besides their applications for learning, devices of this type can be used for library information transfer and for computation, in much the same manner that the small pocket calculators are used today.

In addition to their present and potential use as instructional devices, computers are now playing a major role in education as a management information tool through use of a data base in support of administrative activities. The functions of record-keeping, scheduling, personnel, purchasing, etc., are all valuable adjuncts to the educational process, and require as much time and attention as teaching itself. The management role of computers probably will not change drastically in the next 20-25 years, although actual specialized computer applications will inevitably change quite radically, as indicated above.

In summary, computer systems and peripheral devices (such as terminals) for the year 1980 will have a processing speed 10 to 50 times that of the present systems, and improvements in circuit performance will make the systems ten times as efficient as today's. Processors of the 1980's will be specialized; for example there will be micro-processors containing microcoded stored logic and, where speed is essential, utilizing "wired logic." Between 1977 and 1980 small processors will act as controllers (front end processors) to control larger operating systems, and the costs of controllers will drop dramatically, along with those of processors and other components. Mini-computers will also be cheaper and more abundant, with a wide variety of options for individual applications ranging from batch processing and interactive use to laboratory control and data analysis.


Touchtone Telephone Pad
Receive Only
BATTERY
ON
Data
Privacy
Trans-ceiver
External Accessory
Fine or Coarse Grid Cursor
Test
Light Pen (On-Off)
PLASMA DISPLAY PANEL
ACOUSTIC COUPLER
TEST PANEL
HD
FD
ON
OFF
SPECIAL FUNCTIONS
Light Pen
ON OFF
Digital-audio Cassette Chamber
Combination Microphone and Speaker

AN ELECTRONIC BLACKBOARD
FOR THE PERIOD 1980
(Not to Scale)

Figure VIII-A

Electro-mechanical types of card readers, punches, printers, etc., will remain in use, with the higher cost laser beam printers used where speed is more critical than cost. Thermal printer process terminals will also continue to be used, with costs remaining at present levels. Voice digitalization for computer inputs with automatic printed outputs will become more common for specialized applications such as order and inventory control, but the capability of this technique will be very limited.

In the area of programming languages, audio-activated diagnostics and formatting procedures will be built into systems as microcoded subcomponents for ease of use. Data base management will be simplified in the future by completely automated system functions. Command languages or repertoires will also become simpler and will approach a natural language vocabulary. Data traffic is expected to increase at an annual rate of 35 percent through 1985. Packet switching of data through the use of value added networks will be common in the 1980's because of their rapid response time, low error rate, high reliability, lower cost, and improved transmission techniques (pulse code modulation).

In the field of software, the trend toward microcoded functions in the machine itself will replace some of today's operating system software. Relatively simple monitors will replace some other major functions like job scheduling, error monitoring, and non-sharable device allocation. System management software should be available by 1985 to allow automatic control of external activities such as tape and disc library control, external job scheduling, and user accounting and billing. Programming will also become less complex as the machine will become able to provide much of the programming documentation. This and other aids should cut program development time in half. Software prices, however, will rise because of greater value and complexity.

Interactive Television

One of the newer educational technologies is two-way (interactive) television, which can broadcast to all users with a return path provided by a touchtone telephone linked to a computer for acceptance of keyed responses. Several experiments of this type have been conducted by Queens College in New York City through the cooperation of one of the city-owned television stations and the IBM Corporation, which furnished the computer facilities for the test.

Still further in this vein, Stewart W. Wilson, of the Massachusetts Institute of Technology, has developed a new recording structure which he calls an "interactive lecture," and which consists of a recorded lecture by an authority on the subject. The recording, in high-fidelity audio transferred to cassette, with Electrowriter sketches made by the speaker as he/she lectures and recorded on the second track of the tape, is accompanied by: (1) a "map" of the lecture, consisting of an outline of the main talk and a listing of main questions with reference to the subject and their index numbers; and (2) the cassettes with answers recorded by the original lecturer. In developing this system Wilson used student questions in response to the original lecture material and answers by the original lecturer to compile an interactive lecture. The making of such a lecture employed recording technology and an empirical methodology to discover and collect lines of inquiry around a given topic in order to make them available, at one time and in one place, to the interested listener.

The experiment proper began after the lectures were completed and 48 MIT students came over a period of four months to try them out. Results showed that: (1) there was close correlation between a student's background interests and the particular interactive lectures he/she chose to hear; (2) students did use the interactive lectures "interactively"--they stopped frequently during the lecture to hear answers to related questions; (3) students felt that the questions accompanying the lecture were sufficiently complete; and (4) the voice/Electrowriter combination was found by many students to be surprisingly effective and personal and they did not feel that information gained by seeing the speaker would be worth the added expense. This experiment with interactive lectures suggests that technology's contribution to education should occur not so much in the programming of instruction, or even in the further development of media, but instead in the creation of individually responsive systems in which the size is not so important if the material is generated by the right technique. Wilson suggests that his experiment responds to two needs: (1) for closer individual relationships between students and faculty; and (2) for new opportunities and resources through which a student can teach himself/herself. He envisions an Interactive Learning Center where interactive recordings on many topics are available to all students at any hour. The main functions of the center would be: (1) to act as an "impedance-matcher" between a student who wants to learn a certain thing and an expert and responsive person who knows that thing well; (2) to create new interactive recordings through the participation and contribution of students; and (3) to perform research--developing new interactive technology and testing new devices experimentally with students. (Wilson, 1972)

Dual Broadcast Transmission Techniques

Another experimental methodology being used by teachers at the present time is that of dual channel broadcast. This is accomplished by the simultaneous presentation of a broadcast of a television program which the class views and a separate FM voice broadcast which the teachers listen to through an earphone connected to a portable FM receiver. A series of written notes are forwarded to the teacher regarding time of broadcast, and frequency of TV channel and FM voice channel. This experiment has been tried by the Region XI (Richardson) Education Service Center in cooperation with a commercial television station. In testing the technique, only small television monitors were used with students. A further means for upgrading the quality of classroom television presentations is described in the rest of this section.

Video Projection Devices for the Classroom

The Texas educational TV system presently places heavy reliance upon individual television monitors for presentation of materials to students in the classroom. Often as many as 8 to 10 monitors are used in one classroom, with each monitor costing $200 or more, and additional costs incurred for coaxial cable, ceiling mounts or stands, etc. This technique is an expensive one in comparison to some of the newer group display techniques, e.g., videoprojectors such as the Videobeam projector manufactured by the Advent Electronics Corporation of Cambridge, Massachusetts. This unit projects a 4' x 6' color image on a lenticular screen, and may be used with a variety of input devices, such as a television receiver, a color TV camera chain, or a video tape deck (cartridge type). Priced at $2795, the unit is readily adaptable to limited classroom viewing. The color fidelity, resolution, and brightness of the projected image are excellent; service and support are available in most large cities in the United States.

Other units of the same type include the SONY videoprojector, which projects a smaller size image (30" x 40") than the Advent unit and is of only fair quality; it does not have the intensity of sharpness of the Advent product, although it costs about the same. The Advent type of projector would be excellent for a small, remote school with no more than 50 students. Since the Advent unit is a prefocused three-gun type, once it is set up it can operate with little adjustment or maintenance support. It also has a flexibility which allows it to be used (1) as a stand-alone unit; (2) with video tape; (3) connected to CATV through a VHF-UHF tuner; or (4) with an antenna and tuner, to receive commercial TV signals.

Video Playback Discs

One of the new technologies which is not yet on the market, but which certainly will be arriving soon, is the video playback disc. These will be discs much like present audio recordings, except that they will be soft or resilient ("floppy") discs, and will contain both audio and video information. They are being designed to play on a yet-to-be-marketed playback unit, and will operate into a TV set to present a program much like a live or taped TV program.

There are at least ten companies now engaged in research and development of an inexpensive video disc recording process and the video disc playback equipment itself. Some of these companies are RCA, Phillips-MCA, Zenith, Telefunken, Decca, Thomson CSF, I/O Metrics, and the Digital Recording Company. Of these, the two most likely to be in the final running for the annual two billion dollar home entertainment market are RCA and Phillips-MCA. Both companies have already demonstrated their prototype systems at technical television trade conferences, and both plan to market their systems, in competition with each other, by 1976.

There are currently four basic approaches to development of the video playback disc: an electro-mechanical method which places pressure or capacitive stylus sensors in contact with the rotating disc, developed by RCA; an electro-optical/laser method which uses a low power laser for either a reflective or a transmissive pickup, developed by Phillips-MCA; a magnetic process which reads information much in the manner of a video tape; and a digital recording process using laser techniques. Disc speed is not standardized either at this point, although the industry is sensitive to the need to avoid a conflict regarding method or speed similar to the 45-33 RPM disagreement. Potential applications of the laser method, as delineated by the Battelle Institute (1974), are as follows:

Entertainment market. The technique should be able to compete successfully in the entertainment market for audio systems, TV advertising, television cable program systems, and video cassettes for home use. It is estimated that a player device, smaller than an attaché case, could be built for less than $300. Each record would be a circular photographic film, laminated in plastic, which could be produced at a cost of only a few cents (exclusive of the software cost). Hi-fi units could also be produced which would be small enough to fit into an automobile dashboard and would contain a quadraphonic system with a dynamic range greater than that of any existing recording devices. It would not be limited to the low frequencies or the high frequencies, and would not introduce any distortion into the system or cause any wear on it during playback.

Video records could be produced for TV advertising as 60-second "spots" which could be placed in an automatic changer at the station and sequenced more precisely and accurately than is the case with the present tape or film chain units. The records would be cheaper to make and to mass produce than the chain units, and the capital cost to TV stations would be less because fewer "spot players" would be required. Labor costs for setups would also be reduced.

Computer market. This technique would have value for mass or archival storage systems, as each unit could hold between 10^{13} and 10^{14} bits, with about 10^9 bits on each of several thousand plates. The system could random access any bit in 2 to 3 seconds. The size or capacity remommended for present system use is 10^8 bits.

Education and information retrieval market. In this application, each unit would be more like the present TV system than a computer peripheral. Each disc or record would contain TV frames, but each frame could be addressed independently and could be displayed as a still frame for as long as desired. Digitally coded instructions could also be multiplexed on separate data channels to be used as the basis for student interaction. Because of the enormous number of frames available on each plate, the student could access the equivalent of a computer interactive teaching system without the computer.

Information retrieval machines for specialized subject areas would be basically similar, except that the indexing would be more extensive and it would be possible to search automatically for key words. Multiple branching could be integral to the curriculum. While present day prototypes built by Battelle use high powered laser units and precision optics plus exact positioning (x - y) mechanisms, proprietary methods have been discovered which allow for "hobby" grade laser units, optics, and positioning equipment. Preparation of imagery could employ photographic, polaroid, photochromic, or related non-silver image processing methods.

Problems inherent in the adoption of these techniques include:

(1) General acceptance by present magnetic tape and film users in industry and education;

(2) Determination of what future standards will be, since the technology is very dynamic and subject to change and breakthroughs are unpredictable;

(3) Testing of the reliability of the techniques and validation of the claims concerning them; and

(4) Testing of the methods in a real-life environment.

All types of video playback disc can be produced rapidly and inexpensively, as compared with video tape. The industry hopes to market the discs and the playback units at costs similar to those of quality audio discs and units, and expects thereby to cause a quantum change in the social fabric of American life. Certainly for education the discs appear to present endless possibilities. For example, entire segments of courses of instruction could be placed on video disc, thereby making the instruction individualized, inexpensive, and technologically available to every school. As of this writing, the decision as to whether to adopt one system (Phillips-MCA or RCA) and make it standard nationwide has not been made. Many scientists, however, favor the laser-beam scanning method.

Laser Holography

One of the newest technologies currently being used in education in the engineering sciences is the three-dimensional depiction of an object by laser holography. The word "holography" was coined from the Greek words holos (whole) and grapho (to write) by its inventor, Dr. Dennis Gabor, Nobel Physics Laureate of 1971. It may be defined as the science and technique of recording (or otherwise using) all the information content of waves transmitted, reflected, or scattered from objects, which can be stationary or moving. Any class of waves may be used, from long radio waves to x-ray wavelengths, as well as the entire spectrum of longitudinal wave energy. The material that photographically records the wave information from a test object is called a hologram. When such a hologram is properly illuminated, a three-dimensional image of the original object can be formed or reconstructed. The entire system forming the hologram and reconstructing the object's image is called a holographic system. The underlying principle of holography seems to be that the amplitude and phase information of a reflected or scattered optical wave from an object can be recorded by interaction or "interference" between the object wave and a coherent background reference wave.

The basic difference bwtween photography and holography is that a photograph records an object image, whereas the hologram records the entire object wave. The coherent light source necessary for the reference wave became available with the discovery of the laser beam. So. although holographic theory dates from the 1940's, actual demonstration was delayed until the 1960's.

Three-D images can be obtained by the holographic process because amplitude and phase information is recorded for every point on an object. In conventional photography only intensity of light waves is recorded (the amplitude squared); all the phase information is lacking since photographic film cannot respond to it. The hologram, however, varies in density to respond to phase information received from each point. Some useful applications of holography are: (1) to detect stress or deformation of machine parts or flaws in circuitry; and (2) spaced in time, to aid in the study of shock and vibration. Holograms can also permit the study of fluid density, temperature, and flow, without inserting probes that would change the pattern, and holographic principles have been applied to mapping terrain with radar waves and exploring tumors and body structures acoustically without surgery. Holographic techniques also make possible the storage of a large amount of information in a small space--200 times as much as is possible with microfilm or microfiche. Such stored material can also be read back at a much higher speed. Holographic films are now possible, too, and may be produced shortly. (Dudley, 1973)

The most radical impact of the use of laser holography has been on industry in the area of quality control. Its utility in education in teaching the laser holography principle and demonstrating the associated phenomena has been established, and many high schools have inexpensive laser beam systems as part of their science laboratory programs.

Picturephone

The Bell Telephone system devoted many years to the development of the Picturephone, which was intended to be the start of a new era in communications. The purpose of the Picturephone system was to allow callers to dial another subscriber with a similar device and not only to talk but to observe the other person. The wideband requirement for this type of channel (1 MHz) was approximately 500 times that of conventional telephone line. The concept of visual presentation opens up a whole new field to the subscriber in terms of access to catalogs, visuals, lists, menus, etc. Two models of the Picturephone were built, the second with many advanced features such as a zoom lens for enlarging the field of view of the camera through a simple control knob and an automatic light compensating device for optimum picture presentation when light changes occurred. Experimental presentations were made which involved the transmission of drawings, charts, etc. as close as one foot from the camera.

The engineering design provided for an automatically switched capability using a six-wire circuit instead of the conventional four-wire system. Experimental links were in service between Pittsburgh, Washington, D. C., and New York City. Unfortunately, the potential market for this type of service proved insufficient to warrant the investment of capital plant, and the entire Picturephone program has been held in abeyance, with Bell stating that the Picturephone would not be commercially available for reasons given earlier in this chapter. While Bell had ambitious plans for interfacing the Picturephone to commercial TV sets, as well as for providing the capability for playback of video tapes, the extent of implementation of these plans is presently unknown.

Dial Access Audio and Video

Other than the telephone system, relatively few dial access systems have been solidly successful to date, primarily because of the lack of software for use in such systems and the large amount of down time in the earlier ones. As equipment has improved, more recent systems have begun working more satisfactorily. Some allow remote access through the telephone or through a similar instrument for purposes such as obtaining reference materials in a college dormitory room. Other systems require the user to be present at a learning resources center, and in such cases the advantages of dial access over audio tape, video tape, slide/tape, or other media formats diminish rapidly. Institutions may, even in the future, prefer to retain the recorded, transportable media for on-site use and to depend upon dial access systems for remote use.

The main province of dial access very likely may be the home learning system, using cable (CATV) connections for either one-way or two-way audio and video communication. These systems may be tied to computer management facilities for testing and for record-keeping. Remote access to print and two-dimensional graphic materials may be through computer output microform systems tied to the dial access system. Thus, actual documents could be accessed remotely. In the longer range future, three-dimensional items may be available as part of dial access systems through the use of holographic techniques.

Libraries/Learning Resource Centers

In both the short range and the long range future, it is unlikely that there will be substantial changes in many of the current functions of libraries and learning resource centers, such as acquisition, reduction, cataloging, indexing, presentation, provision of access to information sources and learning materials, and assistance in using them. A number of the resource center subsystems, however, may change quite radically as the formats in which information is stored change and as the networks that provide access to the data become increasingly widespread and complex.

Sophisticated bibliographic control systems and on-demand publishing and production from computerized data bases may provide for remote printing or production of materials. Dial access computer output microform video systems with CRT/printer capabilities may also allow almost instantaneous access to information, regardless of its location, and may provide the user with hard copy on site, thus completely negating the current need for printing and ordering of hard copy materials. Nonetheless, LLRC's will still be the source of bibliographic tools and of access equipment.

Information reduction in the form of abstracting, cataloging, and indexing will continue to be a vital function; in fact, it is becoming increasingly critical as the volume of information increases exponentially. The means by which this function is carried out will change, however. Automatic subject indexing using computer systems that are capable of handling natural language will increase. As the time of professional personnel becomes a larger portion of the cost of education, the need for abstracting and reduction of information will become more critical. Cataloging functions, especially those related to bibliographic description, will still require human input, but through increasingly sophisticated and complex bibliographic networks, such as the Ohio College Library Center, AMIGOS, and the Southeastern Library and Information Network, the input of one cataloger can be available immediately for remote output at sites throughout the country via telecommunications. The preservation functions of LLRC's will also continue, but probably will focus on miniaturization and holographic storage techniques.

Provision of access to information and learning materials is the purpose of all the foregoing functions. Easier access, however, will be possible on a remote basis. Where patrons need assistance in remote access, broadband communications will allow display of content and interactive voice communications between persons who are separated geographically. For certain types of information, it is likely that users will willingly accept remote, soft copy access. For other materials, including recreational and some types of learning materials, tangible hard copy that can be carried around by the user still will be more popular. Thus, while the use of books, journals, or pamphlets may decline somewhat, a continuing need for them is anticipated.

With regard to the personnel who provide assistance to users in LLRC's, changes may be anticipated in deployment and in professional preparation. Computer and media literacy will be accepted prerequisites, and the analysis of client needs and provision of whole documents/software and/or parts of documents/software to meet those needs will be standard job requirements. The line between print and other information-carrying formats will blurr to oblivion.

Thus, given the premise that existing copyright questions will be resolved, the LLRC of the future will continue to be a place for storage, but, more importantly, it will become a point of access to the total bibliographic and storage network structure of the nation or of the world, and will provide the specialized personnel needed to help in accessing and using desired materials.

Home Learning Centers

The home learning center, designed to give learners of all ages convenient, fingertip control over a wide variety of instructional and general educational resources as well as over a certain amount of information needed for daily decision-making, and, in the case of younger learners, to complement those resources available to them in the school, is a concept not only favored by many futurists but predicted to be available within a reasonable price range in just a few years. (Baran's views of the potential role two-way interactive television can play in the home have been discussed earlier in this chapter; see list of Futurists and Futurist Societies in the references for names of some other proponents of comprehensive home learning.)

Home learning centers for persons of all ages are most likely to develop in the 1980's in the form of portable cathode ray tube (or plasma display) computer terminals which can access stored information from a remotely located computer via telephone. The constraint that exists at the present time does not lie in the technology itself but rather in the high cost of terminals and the mobility of the average person to use the system. Lavi (1975) describes a dynamic learning mechanism which would handle the educational needs of a person's lifetime through an "open" or continuing system for learning. A consultation agency would provide not only stored and published resources but also a staff of specialists or consultants. Thus, the system would comprise three major elements: (1) the learner; (2) the consultation agency (the socio-psychological element); and (3) a communications access agency (utilizing telecommunications and computer networks). The operation of the home learning center would include feedback mechanisms and would assess and grade the learner's progress, making heuristic (self-adaptive) changes where needed to reinforce learning. The user would, in essence, have access via telecommunications links to a super-library, complete with audio and video materials and courses. In addition to those resources, the system would provide new information regularly with expansion of its data base, as well as updating and storing new course materials. Should a group of learners desire to hold demonstrations, seminars, or discussion groups using video conferencing techniques, this could be arranged without the students having to leave their homes through a special two-way hook-up, so that their questions could be answered by experts inthe field. The home access carrel would have the capability for all types of communication, from simple two-way audio to the more sophisticated inward video, outward voice, or two-way switched video. While such systems are feasible in the foreseeable future, one problem that will delay their implementation is that of high costs. The second factor which may impede their progress entails too much emphasis on the telecommunications technology and too little on the learner. Earlier in this chapter is a description of a primitive prototype system called the TICCIT System, designed by the MITRE Corporation, which has been installed and is now being tested in homes in the community of Reston, Virginia. Primary emphasis is on television learning techniques and not on the total concept outlined above.

FUTURE PERFECT

In the ideal teaching-learning situation of the future, one would probably envision close to a one-to-one ratio; one would hope for agreement on objectives and methods between teachers and parents, or at least for provision of the opportunity to learn both at school and at home; one dreams of a never-failing source of materials, always available immediately to suit the teaching needs of the moment; and one would have to stipulate that all this be financially feasible.

Impossible? Certainly not! Improbable? Not really--the above scenario could be enacted given the present state of the art. Then why not now? For one thing, some people resist change; for another, it is hard for educators to express themselves in terms of reasonable objectives achieved through the techniques that have been proven best; and for yet another, commercial competition muddies the water.

One of the most important changes taking place in education today is in the role of the teacher in an increasingly complex and technologically oriented society. The majority of public school teachers are basically perceptive and can readily cite the adequacies and inadequacies of their own schools because of their direct day-to-day involvement with the students. Much data has been collected concerning the amount of time a typical teacher spends in preparing lessons, teaching, grading, counseling, and a multiplicity of administrative duties, including attendance, student health problems, parental visits, and disciplinary actions, but little has been done to improve the quality of education as well as relieve the teachers of the tedium of the non-teaching tasks. A reappraisal of both our entire teaching system and our administrative/management system should be made, and a long range plan should be developed that takes into consideration the needs of school designers, administrators, teachers, students, and parents in establishing parameters and specifications for a responsive and cost-effective educational system. The following description attempts to outline such a future system in broad terms, but it is by no means a complete or an entirely valid model. It should, rather, be taken as an example to illustrate the point in question.

To begin with, a comprehensive public education system of the 1980's must incorporate a pragmatic management information system for use at all levels; one that contains all essential data to parallel and expand present-day organizational management and instructional programs, procedures, and records. Like it or not, our society has become highly dependent upon computers for all types of tasks, ranging from simple attendance reporting to counseling, testing, and, of late, computer-managed instruction and complex laboratory instrumentation in science teaching. As a result, more and more people are acquiring computer literacy. The computer is here to stay, and more educators are learning to appreciate its role in education and its use in real time telecommunications systems. There is, therefore, a need to assist the administrator and the teacher by providing them with a management system in which information can be stored and from which it can be retrieved simply and efficiently. They do not need to learn to be computer specialists, but they must learn to use the system in much the same manner that they now use their telephones, their television sets, or any other common information transmission media.

Software is the most important element of the entire educational system of the future. We tend to discuss the specifications for the library building, but to overlook the books themselves that are so vital to the transfer of knowledge. The future educational system, therefore, must be designed by a team of specialists, headed by outstanding educators with sufficient expertise to specify administrative, management, and instructional needs. The primary objective of this group must be to give the system the versatility and flexibility at classroom level to assist, and not to burden, the teacher in a wide range of applications, from administration to the most advanced teaching techniques.

To accomplish this, an educational resource data base must be established for all types of instructional materials, including not just content materials, but course materials oriented toward decision-making, concept learning, and self-paced types of individualized learning. The decision-making process should teach individuals to cope with new situations and new techniques and present new technologies in a way that will foster acceptance of change rather than incur apathy or resistance to it. As a part of the change process built into the educational model, we must include an understanding of value judgments and the economic considerations involved in making critical choices. The focus of the system, furthermore, should be on the learner and not on the teachers alone, and the use of visual communications technology based upon telecommunications for individual and home learning systems will be an important adjunct to the main system. Lifelong learning for students from kindergarten children to senior citizens will also be basic to the system requirements.

Some children learn best from pictures, others from the reading of words, others from the verbalizations of a teacher, and still others from group discussions. In fact, no two pupils are the same. The perfect system, then, will be able to bring to each child that mode which best suits his/her learning style, when called for, and at a level of presentation appropriate for that child. The same system should serve the teacher in reducing or eliminating time-wasting duties, and should serve the administrator in management, decision-making, and administration.

While the perfect system undoubtedly will not be implemented in Texas, or anywhere else, for some time to come, we have tried to use its parameters, as we have defined them here, as guidelines for critical thinking about the various technologies and combinations of technologies that are presently available to us, and to generate alternatives, conclusions, and recommendations accordingly. The presentation of this process comprises the following chapters of this report.

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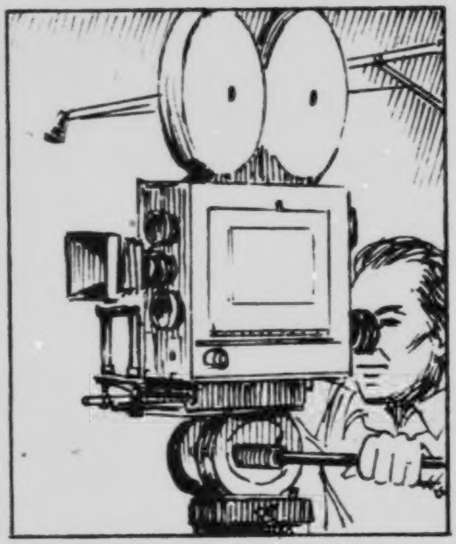
alternatives IX



PRÉCIS

This chapter is the first principal section of the report following Chapters IV-VIII, which comprise the five main fact-finding and information-gathering efforts. It begins the analysis of this data in the same six areas of concern previously identified: strategy, human, technology, political, organization, and finance and ownership. Of these, the technology section is the longest and most complex.

Forty-nine devices and techniques are selected for evaluation. They are first grouped according to their sensory impact; then they are further identified according to whether they use "real time" or recorded materials. The type of telecommunication needed for each technology, the classification of the usual content materials, and the classification of each with regard to capability for interaction are also shown on charts.

Then each of the 49 technologies is ranked according to how well it attains each of the six objectives. The ten lowest are eliminated, and the remaining 39 are ranked according to how well they satisfy the 14 selected criteria. Ten more technologies are eliminated, the objective standings and the criteria standings are combined, the remaining 29 are re-ranked, and eight more are dropped out. Further deletions are made because the technologies either are now in widespread use or show little promise; eleven are thus eliminated.

The remaining ten technologies are analyzed in detail and five more are removed, leaving CATV, CCTV, video cassette, video and floppy disc, and CAI/CMI for final review in the next chapter.

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Method of Approach p. IX-1
Strategy p. IX-1
Human Factors p. IX-4
Technology p. IX-5
Political Factors p. IX-28
Organization p. IX-30
Financing and Ownership p. IX-34
Potentiality p. IX-38
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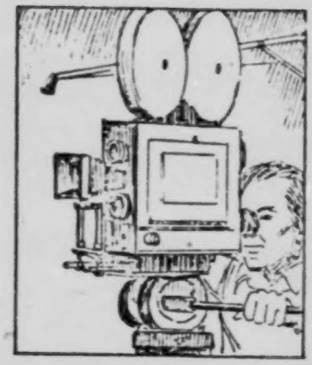


IX

ALTERNATIVE SOLUTIONS

METHOD OF APPROACH

Thus far in this study, the information presented has been essentially factual, collected from different sources on various subjects for several purposes, and there has been little or no attempt to correlate these data or to look for possible interactions. The purpose of this chapter, then, is to attempt to assemble this information in usable form, discuss the significance of its high and low spots, identify the pros and cons of what appear to be feasible solutions, and begin to indicate those concepts, strategies, policies, technologies, and methods of telecommunications that appear to be both feasible and necessary for the state of Texas.

For this reason, the prior chapter on Futures ends with one version of an "optimum solution," if, in fact, any technology is optimal at any time. Any solutions devised in this report must necessarily be a compromise of what appear to be the best and most feasible combinations of factors. Technology has to be the first and leading consideration, but strategic, organizational, political, financial, and human factors all have a very strong influence on future directions. Some of these strongly influence the actual selection of a technology and telecommunications; others are strongly affected by the solution which is selected. For this reason, the sequence of this chapter, while seemingly haphazard, represents the actual sequence of thinking that must occur.

STRATEGY

Paramount in the implementation of any system of educational technology is the establishment of specific strategy and policy guidelines to ensure coordinated and integrated implementation of such a program and to provide educators and administrators with an adequate overview of what is trying to be accomplished. Such strategies in themselves should provide a mechanism for dissemination of policy (and implementation of the changes which surely will occur) and provide pathways for feedback from those persons involved in the program at all levels. Before any such strategies can be formulated, however, certain goals and objectives of the educational system must be defined. Of course, such goals will already have been formulated to some extent as a prerequisite to the examination of the overall question of educational technology, but these should either be recast in light of this examination's findings or firmly defined, as a basis for making a final decision on the matter.

It must be recognized that goals, objectives, strategies, and policies are frequently subject to the temper (political and otherwise) of the time, and thus may change according to particular concerns or needs perceived at the moment by citizens, government, or both. Therefore, in developing any long-term plan which would involve considerable commitments of funds or of personnel, it is extremely important that the goals, etc., be stated in universal terms--concerns which because of their inherent nature (human factors, for instance) are relatively timeless. This is not to say that one should overlook or ignore immediate needs, only that one should not make them the basis for a 20 to 25 year commitment.

In terms of general goals and objectives--concerns or factors which need to be dealt with in order to improve education, which in itself is the major, all encompassing goal--three areas of major concern exist: human, educational, and organizational. Each of these areas contains components or subsets which are themselves important goals and which are discussed below. These discussions, of course, are by no means comprehensive and are presented primarily as guidelines for further discussion and evaluation by policy-making bodies.

Definition and Discussion of Goals and Objectives

Human needs. A chief concern, and one which will continue to be an important issue in the future, is that of providing equal educational opportunity for all pupils within the state, regardless of ethnic background or economic status. As recent court cases have shown, this involves not only equality within districts, but also equality throughout the state, thus requiring the reorganization of certain tax bases and funding regulations. Although the moral question of equality of opportunity was resolved some time ago, the problem of equal distribution of school funding has only recently been raised and has yet to be clearly resolved. Still, the fact remains that we should strive for equal opportunity within our public school system.

Another human need within the educational system involves providing the student with adequate skills (intellectual and otherwise) to function productively and happily within society. Major questions here are what actually constitute "adequate skills" and how these can be developed within the student. For example, although many, if not most, educators see individualization as a most efficient means to provide the student with such skills, others argue that we must not overlook the role of socialization in the schools, as socialization itself is a key tool for subsequent functioning within society. Of major concern here is the need to instill in children the ability to cope with changes within our society, to learn to adapt to such changes,and to learn to function within different environments. Adaptation to change, more than ever, will continue to be one of man's most critical skills, and should be developed to the greatest extent possible by teaching our children about the change process at an early age.

Educational needs. Increasing the efficiency of learning is a major goal which needs to be considered in the overall development of strategy, and one which can be approached from various sides. Clearly, one can increase the efficiency of learning, in terms of cost-effectiveness,either by increasing the amount of pupil learning attained for the same time and/or money or by decreasing the present cost of education without reducing learning effectiveness. However, one must remember that changes in learning efficiency within an individual student do not necessarily indicate the same results within the group as a whole, and the needs of one should be weighted against those of the other.

Another important goal is that of establishing education as a lifelong process rather than one limited to childhood and the teen years. Although it may be considered controversial, viewed in terms of future productivity and, indeed, survival, lifelong education is becoming more and more essential both to the individual and to society. Despite the fact that youth presently comprises the majority of the population and thus will adequately fill the needs of the working force for some time to come, the point will come in the future at which most of the working force is somewhat older, and unless these persons are provided with continuing education, they will find themselves unable to keep up with the requirements of their jobs. Additionally, in the future, most people will probably change jobs more than once in their lives and will need to be retrained or to receive additional training to meet the requirements of their new positions. Thus, learning to cope with changing jobs and lifestyles and training for new jobs will become a real necessity. (Forecasts indicate three different positions during one career.)

Organizational. Increasing citizen involvement is a necessary component in ensuring that an educational system is responsive to the populace, and this includes involvement of all citizens (teachers, parents, administrators, and pupils) on all levels. But as increased community involvement occurs, a further problem emerges which relates to many of the points mentioned above: that of state vs. local control of curriculum and funding.

Guidelines for financial and organizational control must be clearly and comprehensively defined and established, for around this one point revolve the matters of continuing education, equal opportunity, efficiency of education, etc. As is usually the case, the apportionment of funds means a certain amount of control by the funding agency over what is done with the money, and although this is only to be expected, the recipients rarely are totally happy with the arrangement. The citizens of Texas have always guarded closely their right to local control of the school system, and probably are not willing to give it up at this point. However, most will agree that progress must be made along the lines outlined above, and there are compromises which will probably satisfy both local-control and state-control proponents.

To reiterate, some possible educational goals and objectives for which strategies should be developed are:

(1) To provide equal educational opportunity to all pupils within the state;

(2) To provide these pupils with adequate skills to prepare them for the future;

(3) To increase the overall efficiency of education within the state;

(4) To establish education as a lifelong process;

(5) To increase citizen involvement in education on all levels;

(6) To resolve the issue of state vs. local control of educational funding and curriculum.

Note that the establishment of an educational technology system within the state was not listed as a goal since it has been the purpose of this study to determine whether or not there is a need for such a system. As will become apparent, however, the establishment of such a system could serve the state well as a solution to many of the above problems, and hence will be considered as a part of the possible solution strategies rather than as an objective.

The Development of Strategies

Before developing an overall educational strategy for Texas, it is necessary to examine each goal or objective separately and to establish individual strategies for its implementation. After analysis of the results, an all-encompassing, comprehensive strategy can then be identified. The following discussions provide certain contingency plans or alternative strategies for each of the goals mentioned above, although, as stated earlier, they are by no means complete:

(1) To provide equal educational opportunity to all pupils within the state. A possible strategy here would be the establishment of an equitable tax base and distribution system in Texas, thus balancing the monies allocated to each school district and presumably providing an equitable school system. However, as costs of living differ throughout the state, as do teacher salaries and building utility and maintenance costs, true financial equality would be difficult to achieve. Alternate strategies would be to give the parents of each child a "blank check," or voucher, for each year, allowing them to choose which school the child should attend; or to require complete or extensive standardization of curriculum, achievement levels, and school facilities for every school in the state.

(2) To provide pupils with adequate skills to prepare them for the future. This could be achieved by providing more individualization within the curriculum so that students with special needs could prepare for the future to their full potential. Alternate strategies would be the provision of open classrooms in addition to certain amounts of individualization, in order to provide socialization, or the establishment of a lower student/teacher ratio.

(3) To increase the overall efficiency of education within the state. Alternatives here are to allow the student to complete much of his/her work at home, while going to school only 3 to 4 days a week and thus reducing school costs; to provide students with materials which can be used by many other students yet still increase learning by providing individualization (e.g., computer terminals, or learning centers); or to increase the student/teacher ratio, thus reducing costs although possibly reducing learning effectiveness to some extent as well.

(4) To establish education as a lifelong process. Solution strategies here could be free education for citizens of all ages; legislation to require employers to give employees two weeks of time off during the year for educational purposes; or public information campaigns concerning the need for continuing education.

(5) To increase citizen involvement in education on all levels. Again, public information campaigns could provide an impetus for increased citizen involvement in education. Other alternatives are the formation of boards or agencies responsive to citizen input within the schools, districts, ESC's, etc.; or the requirement that citizens review the educational system at specific times by means of questionnaires.

(6) To resolve the issue of state vs. local control of educational funding and curriculum. Here, strategies could include complete state funding and curriculum control; complete local funding and curriculum control; or funding and provision of many acceptable curricula by the state while allowing the local authorities to choose individual courses and text materials.

Finally, bearing in mind the goals and the individual solution strategies established by the decision-making body, administrators should then establish an overall strategy for implementation. Such a strategy should include provisions for organization, funding, and meeting educational and change requirements, and it should be flexible enough to withstand changes in the political or philosophical temper of the country or state. Contingency strategies should accompany the overall strategy, and such strategies should be made known to all involved in the implementation and policy-making process in order to establish firmly the route to be taken and to prevent any misunderstanding of purpose or intent.

As stated earlier, educational technology is not presented as a goal or objective, for it is viewed as a means to attainment of many, if not all, of the objectives listed, and, being flexible, can be adjusted to suit almost any need that arises. Establishment of a statewide system of educational technology would presumably provide uniformity and therefore equality of opportunity for all students, yet would allow local control of individual curriculum and provision for some local funding to meet specific software requirements. The overall efficiency of education would increase, as students would receive individual attention for much of the day. And finally, citizen involvement in education and attitudes toward it as a lifelong process would probably change in the direction of more acceptance of and interest in education by the general public. Channels for citizen feedback would be provided in the organizational structure of a statewide technology system, and the system could be expanded in any direction to adapt to whatever changes occur in education in the future.

HUMAN FACTORS

Despite the fact that this category appears nowhere as such, throughout the criteria which have been used to rank potential technologies in terms of their ultimate utility to the state educational system runs a common element which, at the risk of sounding clichéd, we can only term human. Several of the factors from which specific criteria have been generated are more simply human than political, strategic, or what-have-you, and this element is inevitably a key consideration in every factor. To begin with, any new technology represents a change, whether of greater or of lesser magnitude, and any change represents some sort of threat to many of the people who must implement it. Only through a better understanding of the change process itself can this threat be obviated.

Much research has already been done, and much more will undoubtedly be done, on the process of infusion, or diffusion, of new ideas and the problems of bridging the gap between theory and practice. The nature of the diffusion process and the sequence of steps it entails and the role of the linkage or change agent have been much discussed in the relevant literature. Suffice it to mention here that Beal and Bohlen (1967) delineate four categoriesof changes in educational practice, ranging from a change in materials and/or equipment through an improved practice (involving a change in techniques or methodology) and an innovation (involving a change in materials and a sequence of changes in their use) to a change in enterprise (involving several innovations). Inevitably, widespread introduction of any telecommunications technology into Texas schools must comprise either an innovation or a change in enterprise, and must be carefully planned as befits a major change effort.

To overcome the natural trepidation of most persons when faced with some degree of disruption of what has become a comfortable daily routine, an understanding of some of the basic tenets of communication and principles of orientation is in order. Communication, by its very definition, involves trying to change another person's way of thinking or feeling in some predetermined way. (Mambert, 1971) Specific objectives involved in such change must, therefore, be determined, and meaningful increments of change established. Human beings are not basically geared to make major, sweeping changes all at once, and the overall process may be thought of as the forging of numerous small links in a chain that will hold strongly once it is completed satisfactorily. Objectives should be small enough to be accomplished but large enough to be significant, and should be stated in terms of an actual activity or observable response on the part of the target population, much as behavioral objectives are posited within an educational system for the learners themselves. The more sophisticated the technology involved, the more complex this process will be, and the more careful planning will be needed to develop the objectives and work out strategies for their attainment. Computer-assisted/computer-managed instruction probably represents the most elaborate of the innovative technologies presently under consideration, and thus would require the most planning and preparation in order to be installed successfully.

Along with the problem of acceptance of change, then, comes the problem of training to implement it. Even if teachers, administrators, and other school personnel welcome an innovation, they may not know how to use it with learners to maximum benefit. Some technologies, for example, broadcast television and radio, clearly have an initial advantage of familiarity over computer consoles and video discs, but educators still may not know when and under what conditions these technologies should be used in preference to some other. In point of fact, even for technologies whose use has been as long studied and as well documented as has that of television, research findings are often conflicting and/or inconclusive. (Chu and Schramm, 1967) An attempt must be made, however, to utilize the best knowledge available in training educators, through seminars, workshops, in-service, and any other means at hand, to make efficient and productive use of the innovative technologies available to them.

TECHNOLOGY

Possible Solutions

A constant problem in generating and examining alternatives has been that of committing an error of omission; that is, leaving out a technology that others might think important. But extreme over-zealousness to include everything would result in a list far too long to handle. A good starting point, therefore, is with the lists of materials and devices found in the Second Draft of the Handbook of Standard Terminology (NCES, August 1974). A listing of devices and techniques from that source appears in Table IX-a.

One would think that a list such as the Handbook's would cover everything relevant; however, we soon thought of some other devices and techniques that had to be considered. As a result of selecting from the above list and then adding our own candidates, we compiled a final list of 49 technologies to be evaluated separately. These technologies (including devices, materials, and techniques) are listed in Table IX-b.

LISTS OF DEVICES AND TECHNIQUES
PUBLISHED BY THE UNITED STATES DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

DEVICES

- Audio Devices
  - Audio Console
  - Audio Mixer
  - Audio Tape Duplicator
  - Audio Tape Player
  - Audio Tape Player, Cartridge
  - Audio Tape Player, Cassette
  - Audio Tape Player, Reel
  - Audio Tape Recorder
  - Audio Tape Recorder, Cartridge
  - Audio Tape Recorder, Cassette
  - Audio Tape Recorder, Reel
  - Audio Tape Splicer
  - Card Tape Machine
  - Headphone
  - Listening Center
  - Loudspeaker
  - Microphone
  - Radio Receiver
  - Record Player
  - Turntable
  - Other

- Computer Devices
  - Computer
  - Computer Terminal
  - Other

- Graphics Devices
  - Diazo Copier
  - Drawing Board
  - Dry Mounting Press
  - Gelatin Process Copier
  - Laminator
  - Light Board
  - Mimeograph
  - Spirit Duplicator
  - Tacking Iron
  - Thermal Copy Machine
  - Xerographic Copier
  - Other

- Electronic Display Devices
  - Film Chain
  - Switcher
  - Television Camera
  - Television Console
  - Television Monitor
  - Television Receiver
  - Video Player
  - Video Tape Duplicator
  - Video Tape Editor
  - Video Tape Player
  - Video Tape Recorder
  - Video Tape Splicer
  - Other

- Photographic Devices
  - Animation Stand
  - Camera, Motion Picture
  - Camera, Motion Picture (Sound)
  - Camera, Still Photographic
  - Copystand
  - Darkroom Accessories
  - Electronic Flash
  - Enlarger
  - Exposure Meter
  - Motion Picture Editor
  - Motion Picture Processor
  - Motion Picture Splicer
  - Processor
  - Slide Sorter
  - Tripod
  - Other

- Projected Display Devices
  - Dissolve Control
  - Filmstrip Projector
  - Filmstrip/Slide Projector
  - Sound Filmstrip Projector, Audio Disc
  - Sound Filmstrip Projector, Cassette
  - Filmstrip Viewer
  - Sound Filmstrip Viewer, Audio Disc
  - Sound Filmstrip Viewer, Cassette
  - Microfilm Reader
  - Microfiche Reader
  - Microcard Reader
  - Microprojector
  - Motion Picture Projector
  - Motion Picture Projector, 16mm
  - Motion Picture Projector, 8mm, Reel
  - Motion Picture Projector, 8mm, Cartridge/Cassette
  - Overhead Projector
  - Opaque Projector
  - Programmer
  - Screen
  - Rear Projection Screen
  - Front Projection Screen
  - Slide Viewer
  - Lantern Slide Projector
  - Sound-on-Slide Projector
  - Stereoscope
  - Television Projector
  - Other

Table IX-a

(Continued on the next page)

LISTS OF DEVICES AND TECHNIQUES
PUBLISHED BY THE UNITED STATES DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE (cont.)

TECHNIQUES

- People-Based Techniques
  - Crossage Teaching
  - Crossage Tutoring
  - Discussion
  - Group Work
  - Lecture
  - Peer Teaching
  - Peer Tutoring
  - Recitation
  - Seminar
  - Team Teaching
  - Tutoring
  - Other

- Setting-Based Techniques
  - Field Experience
  - Field Trip
  - Laboratory Experience
  - Open Classroom
  - Open Corridor
  - Shopwork
  - Other

- Material/Device-Based Techniques
  - Autoinstruction
    - Computer-Assisted Instruction (CAI)
    - Programmed Instruction
    - Other
  - Correspondence
  - Multimedia
  - Radio Instruction
  - Remote Access Information System
  - Telephone Instruction
    - Telewriting
    - Telelecture
    - Teleclass
    - Telephone School-Home Instruction
    - Other
  - Television Instruction
    - Educational Television Programming (ETV)
    - Instructional Television Programming (ITV)
    - Other
  - Other

- General Techniques
  - Audiolingual Method
  - Comparative Analysis
  - Demonstration
  - Directed Observation
  - Dramatization
  - Drill
  - Experimentation
  - Manipulative and Tactile Activity
  - Modeling and Imitation
  - Practice
  - Problem Solving
  - Project
  - Simulation
  - Other

Table IX-a

LIST OF 49 TECHNOLOGIES SELECTED FOR USE IN THIS STUDY

- Audio Card, Slide, Page
- Audio Tape
- Book
- CAI/CMI
- Chart
- Computer Magnetic Tape
- Digital Cassette
- Facsimile
- Filmstrip
- Hollerith Card
- Holographic Image
- Holographic Record
- Interactive TV
- Journal
- Mark-Sense Card
- Microform
- Overhead Transparency
- Pamphlet, etc.
- Phono Disc
- Picture Set
- Picturephone (Confravision)
- Polarized Overhead Transparency
- Printed Page
- Punched Paper Tape
- Radio
- Silent Motion Picture
- Silent TV
- Simulator
- Slides
- Slow Scan TV
- Sound Filmstrip
- Sound Motion Picture
- Sound-on-Slide (Magnetic)
- Sound Page (Magnetic)
- Sound-Slide Set (Synchronized)
- Still Video Record
- Talking Book (Magnetic)
- Telephone
- Teleprinter
- Television (Broadcast)
- Television (CATV)
- Television (CCTV)
- Telewriting
- Toys, Games, Realia, Etc.
- Video Cassette
- Video File
- Video/Floppy Disc
- Videorecorded Telewriting
- Video Tape

Table IX-b

Several of these technologies may be unfamiliar to a number of readers; all are described in Appendix Echo. Clearly, there are many more devices and technologies which each reader will call to mind; however, we feel that this group representsall the communication needs, methodologies, problems, and idiosyncracies that an even longer list would spawn.

It should also be noted that some of these technologies or devices are already in existence and/or may not require the use of telecommunications. These were selected and included intentionally as "baseline" entries, on the premise that evaluations of new technologies could refer back to them and thus would not fall totally into the "Cloud 9" category.

Considerations

One basic problem in analyzing telecommunications solutions is that fact that the general technology and methodology of any particular kind of telecommunications are hopelessly entwined with various other educational technologies. That is to say, in many cases both a certain technology and a certain type of telecommunications are subsets of a single, unified system and thus are not easily separable, so that it is not really possible to think in terms of the technologies alone. On the other hand, many educational technologies are not tied to any telecommunications, and some few can utilize more than one method of telecommunications. Nevertheless, in order to arrive at an accurate description of telecommunications requirements, it appears best to begin by determining the most logical and productive educational technologies to use in a statewide system and then extrapolating this information to the necessary telecommunications requirements. Where possible, then, the technologies are kept separate from the telecommunications, although in many cases they must be examined and evaluated simultaneously.

Fortunately for education, but unfortunately for the methodology of this study, in most cases a single type of educational technology is not sufficient, so that solutions to be considered are really logical groupings or combinations of technologies. These technologies cannot be exclusive of each other, but should be compatible in operation, supportive of one another, and able to utilize the same kinds of telecommunications. No discussion of the combinations of technologies, however, can proceed until discussion of the pros and cons of each technology alone takes place. In the long run, then, there are many, many values for each technology that must be determined, discussed, and weighed in order to determine the total impact, both positive and negative, of each technology upon the educational profession. This process, as it has evolved in this study, is presented here in a combination of matrices, with each matrix identifying major intersecting factors. The discussion that could conceivably accompany each of these charts would be quite lengthy and is therefore omitted; however, major points are explained so that the reader can understand the charts and questions can be answered as they may develop.

Groupings

There are several aspects of each technology which must be considered so that the nature and extent of its possible utilization can be understood and it can be ranked in relation to other technologies.

One of the first dimensions to be considered is that of the sensory nature of each technology. Such a classification is important because, depending on the content material, the sensory reaction may be particularly vital and it may be impossible to transfer some content material properly using only one, or one particular, sensory technique.

After considerable thought, we decided that all the technologies could be grouped under the following headings, according to the type of messages they can carry:

Audio/Motion/Visual
Audio/Still/Visual
Audio/Semi-Motion
Still/Visual/3-D

Motion/Visual
Still/Visual/2-D
Audio
Verbal/Visual Symbol

Timeliness

Another essential consideration is whether a specific communications technique is "real time" or whether it is "recorded." Frequently, the term "real time" is used to refer to a technique which can provide interaction; that is, the student or other person receiving the information has the opportunity to discuss problems with, or ask questions of, the person presenting it. If the technique is "recorded," then this opportunity is not available and the information goes from the source to the receiver on a one-way basis. In this study, we have used the expression "real time" to refer to programming which is presented via a person with whom live interaction can take place. Hence, such programming is also called "active." This does not necessarily mean that all the action in the program is live: some might comprise recorded material presented by the instructor, but the instructor will at least be available for interaction or response. Recorded material, which we have identified as one-way, may also be considered as "passive," unless the instructor adds active comments. Upon examination, we found that, except for the still/visual/3-D category, all the sensory categories listed above contain both real time and recorded technologies, and we have indicated this on our matrices.

Telecommunications Usage

Another kind of categorization is by the type of telecommunications that would normally be used for each technology. There are several technologies which can employ any one of several methods of telecommunications, there are some which do not use telecommunications at all, and there are some which use and/or can be used by only method. These categorizations are presented in the matrix comprising Table IX-c, to indicate the limitations of the 49 discrete technologies with regard to use/non-use of telecommunications.

Interaction

Yet another classification of each technology is an indication of its capability for interaction. To determine this, we discussed each technology, and found that most of them fell clearly into one of two groups; that is, the technology was either one specifically programmed for, and therefore capable of, interaction, or else it was definitely not interactive. There were a few, however, that possessed the capability for interaction but were also used to a significant extent in a non-interactive mode. Therefore, we are placing each technology in one of three categories: interactive, non-interactive, or both. A very few which could be shown as "both," but which are normally used almost exclusively in one of the two main categories, are classifed according to the predominant category. (See Table IX-d.)

Content

A further essential classification relates to the kind and purpose of content material that can be presented through a given technology and thus transferred by some method of telecommunications, if one is involved. Our examination of the various technologies indicated that some of them are particularly good for providing enrichment or reinforcement materials, but are not as suitable for presentation of core content as are the classroom techniques that a teacher typically uses in presenting material and discussing it with children. The various technologies are utilized differently and achieve differential results for different content materials; thus, they are classified accordingly and existing limitations are pointed out in Table IX-d.

Comparison

In terms of objectives. Early in the study, we established a list of objectives to be accomplished by the study itself and a further list of objectives to be achieved by whatever telecommunications methodologies are recommended. There are six of these latter objectives, and they are presented on a matrix in Table IX-e together with the various technologies to demonstrate the extent to which each technology achieves each of the objectives.

LIST OF THE 49 TECHNOLOGIES SHOWING USE OF TELECOMMUNICATIONS

Table IX-c

		Does Not Use Telecommunications	Uses Telecommunications				
			Landline	Microwave	RF Broadcast	Optical (Includes Optics, Laser, and Infra-Red)	Satellite
AUDIO/MOTION/VISUAL	*Television (Broadcast)		x	x	x	x	x
	*Television (CATV)		x	x			
	*Television (CCTV)	x					
	*Picturephone (Confravision)		x	x	x	x	x
	Video Tape	x					
	Video/Floppy Disc	x					
	Video Cassette	x					
	Holographic Record	x					
	CAI/CMI		x	x		x	x
	Sound Motion Picture	x					
AUDIO/STILL/VISUAL	*Slow Scan TV		x	x		x	x
	*Interactive TV		x	x		x	x
	Still Video Record		x	x		x	x
	Sound Filmstrip	x					
	Sound-Slide Set (Synchronized)	x					
	Sound-on-Slide (Magnetic)	x					
	Sound Page (Magnetic)	x					
	Talking Book (Magnetic)	x					
AUDIO S-MTN	*Telewriting		x	x		x	x
	Videorecorded Telewriting		x	x		x	x
	Polarized Overhead Transparency	x					
STILL/VIS/3D	Simulator	x					
	Holographic Image	x					
	Toys, Games, Realia, etc.	x					
MTN/VIS	*Silent TV		x	x	x	x	x
	Silent Motion Picture	x					
STILL/VISUAL/2-D	*Facsimile		x	x	x	x	x
	Chart	x					
	Filmstrip	x					
	Picture Set	x					
	Microform	x					
	Slides	x					
	Printed Page	x					
	Overhead Transparency	x					
	Video File	x					
AUDIO	*Telephone		x	x		x	x
	*Radio		x	x	x	x	x
	Audio Tape	x					
	Audio Card, Slide, Page	x					
	Phono Disc	x					
VERBAL/VISUAL SYMBOL	*Teleprinter		x	x	x	x	x
	Book	x					
	Journal	x					
	Pamphlet, etc.	x					
	Punched Paper Tape		x	x		x	x
	Hollerith Card		x	x		x	x
	Mark-Sense Card		x	x		x	x
	Digital Cassette		x	x		x	x
	Computer Magnetic Tape		x	x		x	x

*Indicates "real time" technologies; all others are "recorded."

LIST OF THE 49 TECHNOLOGIES SHOWING CONTENT AND INTERACTION CLASSIFICATIONS

Table IX-d

		Content Classification				Interactive Classification		
		Fundamental	Enrichment	Reinforcement	Combinations	Interactive	Non-Interactive (Passive)	Both
AUDIO/MOTION/VISUAL	*Television (Broadcast)		X	X	X			X
	*Television (CATV)		X	X	X			X
	*Television (CCTV)	X	X	X	X			X
	*Picturephone (Confravision)		X			X		
	Video Tape	X	X	X	X		X	
	Video/Floppy Disc	X	X	X	X		X	
	Video Cassette	X	X	X	X		X	
	Holographic Record		X				X	
	CAI/CMI	X	X	X	X	X		
	Sound Motion Picture	X	X	X	X		X	
AUDIO/STILL/VISUAL	*Slow Scan TV		X	X	X		X	
	*Interactive TV	X	X	X	X	X		
	Still Video Record		X	X			X	
	Sound Filmstrip	X	X	X	X		X	
	Sound-Slide Set (Synchronized)	X	X	X	X		X	
	Sound-on-Slide (Magnetic)		X	X	X			X
	Sound Page (Magnetic)	X	X	X	X		X	
	Talking Book (Magnetic)	X	X	X	X		X	
AUDIO/S-MTN	*Telewriting	X	X	X	X			X
	Videorecorded Telewriting	X	X	X	X		X	
	Polarized Overhead Transparency	X	X	X	X		X	
STILL/VIS/3D	Simulator	X	X	X	X	X		
	Holographic Image		X	X	X		X	
	Toys, Games, Realia, etc.	X	X	X	X			X
MTN/VIS	*Silent TV		X	X			X	
	Silent Motion Picture		X	X			X	
STILL/VISUAL/2-D	*Facsimile	X	X	X	X		X	
	Chart		X	X	X		X	
	Filmstrip	X	X	X	X		X	
	Picture Set		X	X			X	
	Microform	X	X	X	X		X	
	Slides	X	X	X	X		X	
	Printed Page	X	X	X	X		X	
	Overhead Transparency	X	X	X	X		X	
	Video File		X	X				X
AUDIO	*Telephone		X	X	X			X
	*Radio		X	X	X		X	
	Audio Tape	X	X	X	X			X
	Audio Card, Slide, Page		X	X	X			X
	Phono Disc		X	X	X		X	
VERBAL/VISUAL SYMBOL	*Teleprinter	X	X	X	X			X
	Book	X	X	X	X		X	
	Journal		X	X	X		X	
	Pamphlet, etc.		X	X	X		X	
	Punched Paper Tape	X	X	X	X			X
	Hollerith Card		X	X	X		X	
	Mark-Sense Card	X	X	X	X			X
	Digital Cassette		X	X	X		X	
	Computer Magnetic Tape	X	X	X	X			X

*Indicates "real time" technologies; all others are "recorded."

LIST OF THE 49 TECHNOLOGIES SHOWING ATTAINMENT OF EACH OBJECTIVE

Table IX-e

		Objectives, Showing the Ranking of Each for Each Technology								
		(1) Instruction	(2) Information	(3) In-Service	(4) Technology Information	(5) Management Information	(6) Administrative	Composite Total of Rankings	Drop-Out Selection	Rankings Based on Composites
AUDIO/MOTION/VISUAL	*Television (Broadcast)	12	13	19	10	28	35	117		18
	*Television (CATV)	7	6	10	5	22	35	85		10
	*Television (CCTV)	6	6	5	1	22	25	65		7
	*Picturephone (Confravision)	7	10	1	4	4	11	37		4
	Video Tape	2	1	3	5	15	12	38		5
	Video/Floppy Disc	2	1	3	5	9	16	36		3
	Video Cassette	2	1	5	2	9	12	31		2
	Holographic Record	25	22	19	10	17	9	112		16
	CAI/CMI	1	5	1	2	2	7	18		1
	Sound Motion Picture	2	10	7	24	25	32	100		12
AUDIO/STILL/VISUAL	*Slow Scan TV	36	25	26	17	17	16	137		26
	*Interactive TV	18	25	19	17	15	19	113		17
	Still Video Record	45	40	41	31	32	25	214	x	43
	Sound Filmstrip	12	18	10	17	33	32	122		21
	Sound-Slide Set (Synchronized)	12	13	1	17	33	19	95		11
	Sound-on-Slide (Magnetic)	27	25	16	25	33	25	151		29
	Sound Page (Magnetic)	36	34	38	39	42	35	224	x	46
	Talking Book (Magnetic)	36	34	38	43	42	35	228	x	47
AUDIO/S-MTN	*Telewriting	36	31	38	17	9	9	140		27
	Videorecorded Telewriting	45	34	34	25	22	12	172		36
	Polarized Overhead Transparency	31	39	16	46	42	43	217	x	45
STILL/VIS/3D	Simulator	12	28	13	29	17	35	134		25
	Holographic Image	36	34	34	31	39	25	199	x	42
	Toys, Games, Realia, etc.	10	44	26	47	47	43	217	x	45
MTN/VIS	*Silent TV	48	40	43	39	39	35	244	x	48
	Silent Motion Picture	48	44	43	43	39	35	262	x	49
STILL/VISUAL/2-D	*Facsimile	27	13	34	10	9	8	101		13
	Chart	36	31	24	31	28	23	173		37
	Filmstrip	18	18	10	31	42	43	162		32
	Picture Set	18	28	26	39	47	35	167		33
	Microform	36	13	26	14	28	16	133		24
	Slides	18	25	7	31	47	32	160		31
	Printed Page	10	6	16	10	9	12	63		6
	Overhead Transparency	18	28	13	43	42	43	187	x	41
	Video File	31	22	26	17	17	9	122		20
AUDIO	*Telephone	36	18	26	14	7	25	126		22
	*Radio	18	13	34	31	33	43	172		35
	Audio Tape	25	22	7	14	25	19	112		15
	Audio Card, Slide, Page	31	31	26	39	33	25	185	x	40
	Phono Disc	31	34	26	31	33	25	180		39
VERBAL/VISUAL SYMBOL	*Teleprinter	12	18	19	5	8	6	68		8
	Book	12	10	19	25	28	35	129		23
	Journal	27	6	24	9	25	25	112		14
	Pamphlet, etc.	7	1	13	8	17	23	69		9
	Punched Paper Tape	45	44	47	31	5	5	177		38
	Hollerith Card	36	44	47	25	5	2	159		30
	Mark-Sense Card	31	40	43	43	9	4	170		34
	Digital Cassette	27	44	46	29	2	2	150		28
	Computer Magnetic Tape	18	40	41	17	1	1	118		19

*Indicates "real time" technologies; all others are "recorded."

The six objectives are also repeated below, arranged in what we consider their possible order of priority, although we cannot distinguish between them sufficiently to provide weightings and still remain reasonably objective:

(1) The system should carry instructional and enrichment items for students;

(2) The system should be able to provide general information to teachers;

(3) The system should have the capability for providing in-service instruction and training for teachers;

(4) The system should provide updating of technological information on a regular basis to teachers and administrators;

(5) The system should be able to provide management information suitable for decision-making;

(6) The system should be able to store and transmit a variety of administrative data.

Six persons who had been engaged in this study from the beginning rated each technology in terms of each objective, using a scale of one to five. A rating of one represented a score of very low or non-existent achievement; five represented very high or perfect. The six sets of ratings were compiled for each objective in relation to each technology, and presented as one display; the raw scores (compilations) were then determined and placed in order of relative ranking within each objective. Additionally, the ratings of each technology were totalled for all six objectives, and these scores were further ranked in descending order. Once these standings were established, we eliminated from further consideration those ten technologies with the lowest standing.

The ten technologies thus deleted were:

Still Video Record
Sound Page (Magnetic)
Talking Book (Magnetic)
Polarized Overhead Transparency
Holographic Image
Toys, Games, Realia, etc.
Silent Television
Silent Motion Picture
Overhead Transparency
Audio Card, Slide, Page

Obviously, some of these technologies are already in use, and, in many cases, successfully so. However, we allowed them to drop out anyway, in some cases because they do not require telecommunications and in others because their existing success precludes them from being considered as truly innovative. The remaining 39 technologies were retained for further cycles of consideration and evaluation.

In terms of criteria. Just as the objectives and the original 49 technologies were related to one another by means of a matrix, the same procedure was used to evaluate each of the 39 remaining technologies against each of 14 of the criteria established in Chapter III. These were the specific criteria which we felt applied also to this particular phase of analysis; after scoring and compiling, it was our intention to weight them, but we found it impractical to differentiate carefully between 14 separate items. We therefore divided the criteria into four separate groups in terms of overall importance, and weighted the groups as follows:

Group I (lowest priority; raw scores multiplied by one)
- (1f) Avoidance of obsolescence
- (3a) Organizational: overall coordination, etc.
- (5a) Supply requirements (financial)
- (5b) Requirements for support personnel

Group II (next highest priority; raw scores multiplied by two)
- (1a) Integration of technology
- (1b) User experience with technology
- (1e) Feasibility of maintenance
- (1g) Training to use the technology

Group III (very high priority; raw scores multiplied by three)
- (1c) Cost-effectiveness of new technology
- (1d) Availability of software
- (1h) Allowance for individualization
- (2a) Political: overall political feasibility, etc.
- (4c) Strategic: user input

Group IV (highest priority; raw score multiplied by four)
- (5d) Overall cost-benefit

The group scores were then compiled, and entered on the matrix for each technology in each group. Then each technology was ranked within each group and these rankings were placed vertically. The weighted raw scores were totalled and entered for each technology; the total scores were then ranked (see Table IX-f). Finally, the ten technologies with the lowest standings were identified and these technologies were deleted from further consideration. They were:

Holographic Record
Telewriting
Interactive TV
Slow Scan TV
Videorecorded Telewriting
Simulator
Facsimile
Video File
Digital Cassette
Computer Magnetic Tape

While some of these technologies have exciting possibilities, some are inflexible, some are limited in application, and others introduce a real time factor that is not critical.

It should be noted that several technologies were not deleted here in spite of low rankings because they had ranked so high on the objectives matrix that we felt that they needed further examination. These technologies were:

Picturephone (Confravision)
Video/Floppy Disc
Video Cassette
Video Tape

Again, some of the deleted technologies are presently in use, and some others do not need telecommunications. The remaining 29 technologies were retained for another cycle of consideration.

In terms of both objectives and criteria. The next step in our evaluation was to consolidate the relative positions of the remaining 29 technologies with regard to meeting of both objectives and criteria. This was done by compiling their scores on objectives and criteria as equal values, and establishing a new order of ranking. The resulting rankings of the 29 remaining technologies are shown in Table IX-g.

LIST OF 39 TECHNOLOGIES SHOWING RANKINGS BY CRITERIA

Table IX-f

		Criteria Group Rankings, Based on Weighted Raw Scores				Weighted Total of Raw Scores vs. Criteria	Drop-Out Selection	Rankings Based on Weighted Composite Scores
		Group I Ranks	Group II Ranks	Group III Ranks	Group IV Ranks			
AUDIO/MOTION/ VISUAL	*Television (Broadcast)	13	16	21	18	10880		16
	*Television (CATV)	15	17	19	16	10770		17
	*Television (CCTV)	20	19	23	22	9965		21
	*Picturephone (Confravision)	29	26	30	26	8330		31
	Video Tape	25	24	25	28	8975		27
	Video/Floppy Disc	29	36	27	32	8410		30
	Video Cassette	27	23	26	29	8790		29
	Holographic Record	31	38	35	35	6720	x	39
	CAI/CMI	35	21	20	38	9150		24
	Sound Motion Picture	18	13	15	19	11230		15
AUDIO/STILL/ VISUAL	*Slow Scan TV	30	34	33	37	7076	x	38
	*Interactive TV	33	29	36	34	7955	x	34
	Sound Filmstrip	14	9	7	7	12605		8
	Sound-Slide Set (Synchronized)	17	15	12	10	11575		14
	Sound-on-Slide (Magnetic)	16	21	28	21	9100		25
AUDIO/ S-MTN	*Telewriting	29	33	32	31	7615	x	35
	Videorecorded Telewriting	31	37	34	29	7120	x	37
STILL/ VIS/3D	Simulator	34	35	30	39	7564	x	36
MTN/ VIS								
STILL/VISUAL/2-D	*Facsimile	26	31	22	32	8820	x	28
	Chart	1	6	9	13	12995		6
	Filmstrip	10	12	8	8	12510		10
	Picture Set	9	14	13	10	11775		13
	Microform	19	18	20	17	10530		19
	Slides	6	8	10	10	12530		9
	Printed Page	3	5	2	4	14178		4
	Video File	28	30	29	35	8120	x	33
AUDIO	*Telephone	2	4	5	14	13230		5
	*Radio	7	7	18	9	11970		12
	Audio Tape	12	11	5	5	12625		7
	Phono Disc	11	10	11	5	12230		11
VERBAL/VISUAL SYMBOL	*Teleprinter	24	25	16	23	9910		22
	Book	5	1	1	1	14855		1
	Journal	7	2	4	2	14525		2
	Pamphlet, etc.	4	3	3	3	14510		3
	Punched Paper Tape	23	27	24	23	9266		23
	Hollerith Card	22	22	17	20	10025		20
	Mark-Sense Card	21	20	14	15	10647		18
	Digital Cassette	36	28	29	26	8317	x	32
	Computer Magnetic Tape	31	32	22	25	8990	x	26

*Indicates "real time" technologies; all others are "recorded."

LIST OF 29 TECHNOLOGIES SHOWING STANDINGS WITH REGARD TO OBJECTIVES AND CRITERIA COMBINED

Table IX-g

		Relative Ranking for Objectives	Relative Ranking for Criteria	Composite Scores	Drop-Out Selection	Revised Relative Ranking Based on Composite Scores
AUDIO/MOTION/ VISUAL	*Television (Broadcast)	15	17	32		18
	*Television (CATV)	10	15	25		7
	*Television (CCTV)	7	21	28		11
	*Picturephone (Confravision)	4	27	31		16
	Video Tape	5	25	30		14
	Video/Floppy Disc	3	29	32		18
	Video Cassette	2	26	28		11
	CAI/CMI	1	28	29		13
	Sound Motion Picture	12	15	27		10
AUDIO/STILL/ VISUAL	Sound Filmstrip	16	9	25		7
	Sound-Slide Set (Synchronized)	11	14	25		7
	Sound-on-Slide (Magnetic)	20	22	42	x	27
AUDIO/ S-MTN						
STILL/ VIS/3D						
MTN/ VIS						
STILL/VISUAL/2-D	Chart	27	7	34	x	21
	Filmstrip	23	9	32		18
	Picture Set	24	13	37	x	22
	Microform	19	19	38	x	23
	Slides	22	8	30		14
	Printed Page	6	3	9		1
AUDIO	*Telephone	17	6	23		6
	*Radio	26	12	38		23
	Audio Tape	14	4	18		4
	Phono Disc	29	9	38	x	23
VERBAL/VISUAL SYMBOL	*Teleprinter	8	23	31		16
	Book	18	1	19		5
	Journal	13	4	17		3
	Pamphlet, etc.	9	2	11		2
	Punched Paper Tape	28	24	52	x	29
	Hollerith Card	21	20	41	x	26
	Mark-Sense Card	25	18	43	x	28

*Indicates "real time" technologies; all others are "recorded."

With the two previous deletions of ten technologies each, 29 technologies now remained for further consideration. Perhaps it should be noted at this point that certain sensory groups have been deleted entirely, as follows:

Audio/Semi-Motion
Still/Visual/3-D (Soundless)
Motion/Visual (Soundless)

Some of these groups contain technologies which are used to some extent today, but this use is not widespread. Since each of the groups lacks an important sensory element, the use of the component technologies will probably never be extensive, although they have value for certain subjects under certain conditions.

Composite. The third phase of statistical screening involved composite or joint scores for the remaining technologies; that is, the 29 technologies were re-ranked in terms of both objectives and criteria. These two rankings were recomputed into a joint score, which was then re-ranked (see Table IX-g).

From these 29 technologies, the following, having the poorest scores, were deleted for the additional reasons shown:

Chart (21st place)	No telecommunications involved
Picture Set (22nd)	No telecommunications involved
Microform (23rd)	No telecommunications involved, and very poor for group instructional purposes
Phono Disc (23rd)	No telecommunications involved
Hollerith Card (26th)	Not useful for instruction
Sound-on-Slide (Magnetic) (27th)	No telecommunications involved, software specialized and expensive
Mark-Sense Card (28th)	No telecommunications involved
Punched Paper Tape (29th)	Very low instructional value

Three technologies were tied in 23rd position; one of these was radio. It was agreed that radio required further consideration, so it was not removed at this stage. (No technology ranked 24th or 25th because of the three-way tie for 23rd.)

With the deletion of the above eight technologies, in addition to the 20 removed in previous cycles, 21 technologies remained for further consideration. In order of rank, these were:

Printed Page
Pamphlet
Journal
Audio Tape
Book
Telephone
Television (CATV)
Sound Filmstrip
Sound-Slide Set (Synchronized)
Sound Motion Picture
Television (CCTV)
Video Cassette
CAI/CMI
Video Tape
Slides
Picturephone
Teleprinter
Television (Broadcast)
Filmstrip
Video/Floppy Disc
Radio

Further deletions. In the fourth cycle of consideration, these 21 technologies were examined and discussed individually. From the beginning, some of them had been recognized as devices and methodologies already in widespread use and thus not really considerations in the introduction of innovative technology, although they had been included as baseline or comparison items. It was agreed at this point that their further retention on the list served no useful purpose, so they were eliminated. Technologies in this group were:

Printed Page
Pamphlet
Journal
Audio Tape
Book
Sound Filmstrip
Sound-Slide Set (Synchronized)
Sound Motion Picture
Slides
Filmstrip

These ten technologies, as a whole, had had very good scores; these results must be attributed in large part to their familiarity and their relative cost-effectiveness, as compared to the high costs of some of the other technologies.

Another technology, and one that uses telecommunications extensively, was also eliminated at this point: Picturephone. This technology has been field tested (although not as an educational device) by the Bell Telephone Company, and, from a consumer point of view, recent results indicate a rather poor showing. In addition, the cost of wideband circuitry and the expense of switching and terminal hardware puts the whole system almost out of reach. Its utility as an instructional device for more than one person at a time is still questionable.

Final screening. Thus, with the elimination of 11 more devices or technologies, 10 technologies remained active, all of which now use or may use telecommunications. These are (still in ranking order):

Telephone
Television (CATV)
Television (CCTV)
Video Cassette
CAI/CMI
Video Tape
Teleprinter
Television (Broadcast)
Video/Floppy Disc
Radio

Further discussion and examination of these ten technologies is presented in the following paragraphs. (Since video tape and video cassette are so similar, these two are discussed jointly.)

Telephone

Telephone ranked well as an instructional medium on the objectives matrix, especially in the areas of providing teacher information and providing instruction, particularly enrichment. It ranked moderately well for providing updated information and for in-service use. Administratively, as a data transmitting device (except for data phones), it ranked poorly, but had a low moderate ranking as a tool in administrative decision-making.

On the criteria matrix, telephone ranked high in the areas of overall cost-benefit; potential for individualization (with pupil and teacher at either end of a telephone line); political feasibility; and user input.

There are several positive factors involved in the use of the telephone as an instructional medium. It must be recognized that the distribution system already reaches to every school building; that users are adept at using the medium; that user assistance and maintenance are provided by the commercial telephone system; and that it is a totally interactive system, with present teleconferencing techniques allowing input and output at multiple points simultaneously.

Disadvantages are primarily financial and attitudinal. It must also be recognized, however, that telephone is audio only and that where visual materials are required, they would have to be made available locally.

The costs of telephone service are not controlled by the schools or entirely by the state, and thus present an unknown and possibly unpredictable factor. Because there is no competition on a statewide basis, schools are not in a position to select alternative vendors of the service.

Attitudinal factors may be the chief disadvantage. Older adults may tend to view line costs for long distance as extravagant (although these costs may actually be lower than those of other technologies). Pupils' attitudes toward use of the telephone may produce both positive and negative results. Because children and young people in most cultural subgroups use the telephone so extensively, they are comfortable with it; on the other hand, since they are conditioned to such heavy social use of the instrument it may be difficult for them to shift their mental set toward a more serious, intensive instructional use.

CATV (Community Antenna TV; Cable TV)

Cable television had quite a high standing throughout the screening process. Unlike other technologies that had rather pronounced peaks and valleys but averaged high overall, CATV had a fairly flat curve, with no perfect scores, but a line-up of relatively good scores that also averaged high.

CATV has some disadvantages which are limiting, but not insurmountable:

(1) FCC requirements for 20-channel capacity in the 100 largest urban areas;
(2) Problems of extending existing systems;
(3) Lack of interconnection between cable systems;
(4) Cost problems;
(5) Some resistance to the technology on the part of school faculty and staff members.

The above shortcomings apply to CATV used only as a TV service, i.e., delivering network or other prearranged programs to each community. However, were CATV available throughout Texas, one could envision the system being used not only for broadcast TV delivery but also as a communications medium to bring both wideband and narrowband communications to the school and to the home. Given this premise, the following advantages become apparent:

(1) TV programs can be requested when needed, or can be taped from a high quality signal and used as needed;

(2) Programming can be inserted to meet local needs;

(3) There is opportunity for two-way interaction;

(4) Channels can be made available for telephone bandwidth multiplexing, and thus the user can obtain voice and data service, leading to computer service capability;

(5) Wideband channels can be made available up to 35 or more per cable;

(6) In addition to educational uses, CATV can be used for multiple community programs and projects;

(7) Interactive TV and CATV, when available on a community basis for purposes beyond educational ones, can have productive consequences for government, health, business and commerce, political, religious, and social endeavors. Such uses would bring the cost per channel for educational applications to a very low level.

Of course any type of television has certain advantages: it provides both audio and video content and can provide this content in color; the material can be live or recorded; the material may have motion and thus can embody whatever speed and vigor are appropriate; and it can be frozen, backed-up, or repeated. When considered in terms of closed-circuit use for local instruction, the possibilities of CATV are staggering.

Closed Circuit Television

Closed circuit television (CCTV) is widely used throughout the United States to assure delivery of a TV signal to a specific and limited audience. Programming can be either live or videotaped. CCTV is currently used in theaters for special sporting events for which an entry fee is charged, and in the Federation of Rocky Mountain States' HET experiments with the ATS-6 satellite, which ties ten VA hospitals in the Appalachia region together for the exchange of medical information. Some states are presently using CCTV for other educational purposes in scattered locations. The advantages of CCTV include:

(1) CCTV permits maximum control of educational programming to ensure that only those programs which are actually relevant to specific courses of instruction are transmitted and that all those who watch the program receive the same information.

(2) Not all teachers are equally qualified, and CCTV can be used to bring those teachers having special qualifications or skills before a sizable audience, which would not be possible in the average classroom. Experts in various educational fields also gain greater exposure over CCTV than in the school auditorium.

(3) Its signal can be extended to classrooms beyond the normal range of broadcast television, and without regard to distance and/or mountainous terrain.

(4) CCTV assures reception of the television signal in all locations where the program is intended to be received. This technology is not limited by the signal anomalies of broadcast TV, which may limit the latter's reception in locations where the signal might normally be expected to be received.

Disadvantages of CCTV are as follows:

(1) Television treats all students alike, without regard to geographic, socioeconomic, or ethnic differences, and students are not able to interrupt the program and ask individual questions of the television lecturer.

(2) Some teachers may view CCTV as an encroachment on their teaching domain, and thus fight its use as a teaching aid.

(3) When compared with broadcast TV, the use of CCTV is limited to those locations equipped for its particular signal, and it excludes the general public, students not in school, and parents wishing to view the programs.

(4) Special equipment and cabling are required, making the use of CCTV more costly than that of broadcast television.

(5) Because relatively little software is available for TV, the onus rests upon local groups for programming and development of materials; this, plus installation costs, drives the total cost per student hour to astronomical heights.

Video Tapes, Video Cassettes

Video tapes and video cassettes rated extremely high (no. 5 and no. 2, respectively) on the objectives, for the following reasons:

(1) Information for later use by teachers can be sorted rapidly via video tape or cassette, either from live broadcasts or from existing video media.

(2) The use of modular, stored video material is an excellent technique for assisting with or for conducting directed or self-teaching training programs.

(3) The use of multi-sensory video presentation techniques as a rapid means of updating personnel on the technological state of the art is one of the most effective methods of testing material for feedback.

(4) Stored video media still constitute one of the best and simplest techniques for educational enrichment in learning resource centers.

(5) Video tapes and cassettes can store administrative data and input it into a video system as required in a highly flexible and efficient manner.

(6) Video tapes and cassettes can be used to provide management information for proper decision-making through specific remote query or on a broadcast basis in a large network.

Video tapes and video cassettes rated fairly low (no. 30) when evaluated under each of the criteria for the following reasons:

(1) Educators have experienced great difficulty in integrating the video recording and storage media into teaching systems because of their complexity, cost, and stringent engineering and maintenance requirements.

(2) Too few teachers have been or are presently knowledgeable in the use of video recording, duplication, and playback techniques, because of the limited availability of facilities, high training costs, and lack of qualified instructors.

(3) The cost-effectiveness of video storage techniques is very high with regard to the end product, but the costs for royalties, personnel, and equipment are still excessive for the average school.

(4) There is limited availability of quality software (programming) other than through federally subsidized sources (PBS, NTS, etc.).

(5) The kinds of systems described are costly to maintain in terms of both manpower and professional skill levels.

(6) It will be difficult, to say the least, to avoid obsolescence since the field of video disc recording now has five different new processes (none of which has been adopted as the federal standard). The public and industry are waiting to see which process will be selected.

(7) Training teachers to use video recording technologies is costly, complex, and difficult because of logistic problems and non-availability of instructors from the field of education.

However, video recording techniques do rate high as an individualized option for recording of whatever one wishes to select.

Computer-Assisted Instruction/Computer-Managed Instruction

The advantages of CAI/CMI are that:

(1) It is an individualized, self-paced device allowing the student the option of greater responsibility and control.

(2) It is an excellent tool for teaching decision-making and for presenting simulation or gaming techniques to acquaint the student with real life situations.

(3) It is an efficient system for management not only of computer-based instruction, but also of scoring, record keeping, and generation of questions from a large data bank.

(4) It is an effective device for real time laboratory experiment control, data collection, and data analysis.

(5) It provides immediate feedback, reinforcement, and/or enrichment as a supplement to traditional forms of teaching.

(6) Curriculum in use can be updated easily and rapidly on the basis of student data analysis.

(7) Programs and documentation are transferable to other systems, within the parameters of established guidelines and standards.

Its disadvantages are as follows:

(1) The systems are still more costly than traditional instruction per student hour.

(2) The technology requires professionally trained technical support personnel and programmers, which in turn requires an additional budgetary outlay. Educators must be trained in the use of the techniques, and not much courseware is available that has been professionally validated.

(3) There are no large, centralized banks of courseware or teaching materials.

(4) Copyright laws are difficult to enforce or supervise with regard to CAI/CMI-related materials.

CAI/CMI rated extremely high (in first place) on the objectives. This can be attributed to the fact that it does meet all of the objectives: (1) it provides information to the teacher through individualized instructional techniques; (2) it has an inherent capacity for teacher training; (3) it can provide updated information on technology through rapid system input; (4) it does provide a great deal of supplemental enrichment material for students; (5) it can store and transmit a great deal of important administrative information; and (6) it can provide management information for decision-making at all levels.

CAI/CMI techniques rated very low (in 48th place) on the criteria for integration of technology, maintenance, costs, etc. for the following reasons:

(1) Computer technology is a very advanced, complex, and specialized field and its integration into education has been and will continue to be extremely difficult; special training must be given to teachers, requiring costly facilities and professional trainers.

(2) The average teacher is not familiar with computers and thus sees the technology as a threat because of its very unfamiliarity.

(3) The acquisition, operation, and maintenance of computer systems is a costly process.

(4) Software development in-house is also too costly for the average school budget. CAI/CMI systems are still too expensive to acquire and operate per student hour as compared to more traditional educational technologies, and too little commercial software (courseware) exists.

(5) CAI/CMI systems are best maintained under contract by commercial vendors. Often this procedure is too expensive in that it involves an expenditure of 10 percent of the capital acquisition cost per year.

(6) The average life of one generation of a computer system is four to five years before obsolescence occurs, although the usable life can be as long as eight to ten years.

(7) Training teachers to use CAI/CMI is, as indicated in (1) above, a difficult and complex task to carry out because of constraints of time and money.

(8) CAI/CMI does, however, allow for optimal individualization.

As a general observation, two points must be noted: (1) the cost of CAI per student hour is constantly being lowered, primarily through the development and production of miniaturized, inexpensive computers and the growing availability of courseware; and (2) educators are developing successful strategies for the multiple use of computers for management and administrative tasks as well as for CAI, thus lowering the cost of all these functions. As these trends continue, more school districts are finding that computer use can be cost-effective; more widespread use increases experience and number of available programs, and decreases costs still further.

Teleprinter (Other than for CAI)

A teleprinter used as a terminal for receipt of messages, instructions, computer data, scientific calculations, library retrieval, and other non-instructional data, or as a device for sending data to a computer, to a library, to an administrator, or almost anywhere, can serve a very useful purpose. The technology has these advantages:

(1) It is inexpensive to acquire and equally inexpensive to operate.

(2) Since the messages transmitted and received are printed out, it provides a hard copy or recorded data, unlike some verbal or audio systems that do not provide any written output.

(3) Usually outgoing data are prepared in advance on paper tape and can be checked, so that dispatch can occur at a convenient time. Similarly, the copy may be printed out as it is received but also may be read later, when convenient. Teleprinter service, then, is not demanding in terms of time required.

(4) Teleprinting is fairly rapid. Common equipment is available to operate up to a rate of 400 words per minute--faster equipment is available, but is more expensive.

(5) Teleprinter service operates over ordinary telephone lines and does not require extra bandwidth.

(6) In addition to being connected with a specific distant terminal, the same equipment can enter other networks and participate in several nets in turn.

(7) The teleprinter is useful in conveying administrative data and tabular and printout reports, as well as continuous narrative.

Unfortunately, there are several shortcomings that prevent teleprinter service from being a perfect technological answer to educational needs. These are as follows:

(1) The teleprinter cannot transmit visual pictures, graphics, photos, or anything other than alpha-numeric information.

(2) The teleprinter can deliver only a limited number of copies, and these are on a continuous roll of paper; they are not bound and are rather fragile. Thus, the technology is not very useful for public school instruction, in-service teacher training, or any other purpose that involves reaching a large audience and/or delivering a large volume of material.

(3) Efficient operation requires typing skill; the keyboard is the same as that of a typewriter and any attempt to operate it without this skill will be quite slow and tedious.

From an overall point of view, examining teleprinter operation in terms of the six objectives is very much like comparing a moon-shot with flying a kite--they both involve putting things up in the air, and surely the kite does this faster and cheaper. But the significance of the two accomplishments is nowhere near the same. The teleprinter, in this context, is much like the kite--it is fast and cheap, but cannot really be compared to other modern educational technologies when one considers what can be accomplished with million-bit-per-second data transmission and intelligent graphics (cathode ray tube) displays.

Broadcast Television

Broadcast television is currently in widespread use throughout the United States as an entertainment medium, with ever increasing emphasis being placed on its use for formal educational purposes. Programming can be either live or videotaped. Advantages of the technology are as follows:

(1) Its educational use is not limited to the classroom, for it can also be viewed by the student who may be confined to his/her home or to a hospital, and all students who watch a particular program will receive the same information.

(2) Its audience is not limited to regular students; it can also be used after school hours for adult education, and for community programming of general interest.

(3) Parents concerned with what their children are being taught have a ready means of monitoring educational television programs for content and quality.

(4) Not all teachers are equally qualified, and broadcast television can bring those teachers with special qualifications or skills before a greater audience than they would have in the classroom. Experts in various fields also can receive greater exposure over broadcast television than they can speaking live in the school auditorium or the classroom.

(5) Any standard television receiver within the range of the television signal can pick up the broadcast, so that the system is very economical to use.

Disadvantages of broadcast television are as follows:

(1) Television treats all students alike, despite geographic, socioeconomic, and ethnic differences.

(2) Students are not able to interrupt the program to ask questions.

(3) Some teachers may view broadcast television as an encroachment upon their teaching domain and thus resist its use as a teaching aid.

(4) Normally, broadcast television signals can only be received about 35 to 50 miles from the station transmitting antenna, depending on the terrain, signal power, and antenna height, and in mountainous terrain, the TV signal could be severely restricted and its use thereby limited. This is made clear in the case of Kentucky. Further, signal anomalies (fading, interference, skip) may limit reception in locations where the signal might otherwise be expected to be received.

(5) Although enrichment programs abound, the capability of broadcast television for fundamental instruction is quite limited (at least at the public school level) and, in any case, the technology lock-steps the viewers.

Video and Floppy Discs

Many of the newer minicomputer systems use a flexible, 8" circular magnetic-coated disc (called a "floppy" disc) for storage of data. The main advantage of the floppy disc is that one small disc can store up to half a million characters and can easily be loaded into the system for use. Some of the newer, stand-alone educational computer systems selling for $8,000 or less use a cathode ray tube, a central processor with a large capacity core memory, and a floppy disc unit. The floppy disc normally contains the course material (written in a programming language such as extended BASIC) and is inserted into a slot for use. Loading of information and access to the system are very rapid.

Video and floppy discs rated low on the criteria (no. 42) for the following reasons:

(1) Integration of the technology presents many problems at the present time, as there are a great number of experimental systems and none of these have been standardized by the government or by industry.

(2) Potential users are not knowledgeable about video disc/floppy disc recording techniques or uses.

(3) No firm cost data are available other than estimates for the discs themselves. The discs only cost $7 to $10 apiece, but this figure does not include equipment costs, etc. Some manufacturers are quoting total prices from $600 to $1,200.

(4) There is at present limited software for educational applications using stored disc technology, and the fact that video discs constitute a purely recorded medium precludes any development or recording of software on the local level.

(5) The question of maintenance at the school level presents more problems than solutions because of the complex electronics equipment and the technical specialists required.

(6) Avoidance of obsolescence cannot be ensured.

(7) Training in the use of this technology could be difficult, since it is so new that only limited numbers of instructors would be available.

(8) The technology does, however, allow a great deal of flexibility for individualization if the user can make his/her own discs.

On the other hand, video discs and floppy discs rated very high (no. 3) on the objectives for reasons given below:

(1) Both types of discs can provide information to teachers through mass distribution systems, since programs, information or training material can be replicated very rapidly.

(2) Video discs are especially suitable for in-service training programs using television facilities for output. Floppy discs can be used for training through interactive programs placed in a computer and linked to a computer terminal.

(3) Both video discs and floppy discs could serve as excellent vehicles for updating of technological information presented to teachers either individually or in groups through use of networking techniques.

(4) Both media are excellent for storing instructional enrichment materials and transmitting them to students.

(5) Video discs can store and transmit specialized administrative data, e.g., new policies or procedures. For the straight directive type of information, floppy discs are excellent.

(6) Both media can be used to provide management information for decision-making, although the floppy disc is more suitable from the point of view of storage and telecommunications.

Five video disc recording systems presently exist:

(1) The Teldec Pressure Pickup Video Disc System;
(2) The RCA Capacitance Sensing Video System;
(3) Phillips Video Disc Systems (VLP) and special applications;
(4) The MCA Discovision System;
(5) The Thomson-CSF Optical Video Disc System.

None of the above systems has been selected to date by the federal government to serve as an industry-wide standard, although prototypes of all of them have been built and exhibited. Phillips and MCA have now merged together and combined their systems into a single, integrated unit; they and RCA are presently two of the strongest contenders.

The importance of discs in the home entertainment market of the future is what all of the above companies are counting on. The use of discs in educational technology may be even more important. The cost factor will vary according to the replication technique, i.e., whether duplication comprises a single molded process or a transfer (disc to disc) "spin" process.

Radio

Radio, often called the "forgotten medium" in education, did not have particularly high overall scores on the matrices (largely because of its limited usefulness for administrative purposes). Nonetheless, its ready availability as a part of any broadband telecommunications system merits consideration.

Broadcast radio has not been particularly successful in education, possibly because of: (1) the fact that most existing educational radio stations are on FM frequencies, thus limiting their geographic range and requiring more costly reception equipment than that needed for AM stations; (2) the fact that only one program may be broadcast at a time, limiting the audience to whom radio can appeal during any given time segment; (3) the fact that regular users are accustomed to turning the dial and choosing from a variety of commercial radio stations, whereas there usually is only one educational station serving a given area; (4) the fact that some persons feel that pupils who have grown up with television are not satisfied with audio only and require video to hold their attention; and (5) the fact that, with few exceptions, only very limited resources and personnel are provided for educational radio stations, thus limiting both the quantity and quality of programming (National Public Radio is helping to meet some of the programming problems but, again, uses the "broadcast" technique).

Educational radio as a part of a total telecommunications system, however, need not be hampered by some of the disadvantages cited above. Using Broadbent's term "narrowcasting" to describe the potential use of radio, one can see several possible advantages. Radio is a relatively low cost technology; it is widely used and accepted, and therefore politically feasible; it allows user input to programming as well as when the medium is used interactively;

and its hardware does not obsolesce (although the software does). Radio in a telecommunications system offers possibilities for multiple voice channels to accompany a single video channel, especially useful where multilingual audiences are being served (the HET experiment in Alaska is a good example). It allows voice over with video to direct the user's attention to given points. It has a talk-back capability either with video or as pure audio, thus providing an interactive mode. The use of radio in developing countries has shown its utility for adult education, family life education, distribution of agricultural information, basic literacy, intercultural communication, and foreign language education. In order to overcome the objections to an "audio only" format, radio may be accompanied by software, such as listening guides, workbooks, slides, or filmstrips which are available at the campus level, having been distributed prior to broadcast time. The use of radio in this manner in several of the open university programs demonstrates its feasibility.

In the matrices, radio ranks very favorably in meeting the objectives of providing information to teachers and providing instructional enrichment. It ranks moderately well as a means of updating personnel on technological developments and providing in-service education. (The portability of receivers, however, could be a very positive factor with regard to in-service.) Administrative needs are served only slightly. Special attention, then, should be given to the potential of interactive radio for transmitting enrichment programs for academically talented students, especially in small districts.

The above analysis suggests that radio is valuable as an educational/enrichment device for farmers while working, for migrants while travelling and/or working, and for other persons involved in primarily physical activities in relatively quiet surroundings; for public school children it has little further utility than that which is currently being exploited.

Technology Summary

In considering these ten technologies and telecommunications in terms of the various factors, and visualizing them as individual or composite systems existing on a statewide basis, we saw certain incongruities and anomalies. For these reasons, we have deleted five additional technologies from further consideration, with the following comments:

(1) In dropping these technologies, we have not overlooked certain alternative possibilities: some of them are particularly useful for training and education of shut-in, handicapped, and disabled persons; others are useful only for a very few academic subjects.

(2) Some of the systems are now in use, but are about to be replaced by newer and much more economical systems.

(3) Some of the systems are effective in achieving some of the objectives but have limited or nonexistent utility in instructing children or teachers.

(4) The systems deleted are:

- Telephone--here, the consideration is not the telephone circuitry (which could be used in many telecommunications systems), but the instrument itself, as used in verbal communications for instruction and other objectives.
- Video Tape--this technology is now in use, and successfully so. However, the same results can evidently be obtained through use of video cassettes, which are much cheaper and more convenient.
- Teleprinter--this is a very useful method of point-to-point communication, and it will undoubtedly continue to serve educational support functions, but will never play a leading role as an instructional device.

- Radio--this is another technology that has probably reached its zenith. It will continue to be used in certain locations and for certain subject matter.

- Broadcast Television--broadcast TV is currently in use for educational purposes in Texas. In many of the large urban areas, there is no cable service, and broadcast coverage is good. In a few urban areas, both exist, and here the cable service is both more diversified and more reliable, although the cost to consumers is higher. Further expansion of broadcast television does not seem warranted, in view of the already widespread use of CATV and the relative economy of further expansion.

Thus, five technologies remain for further consideration:

Cable television (CATV)
Closed circuit television (CCTV)
Video cassette
Video/floppy disc
CAI/CMI

These will be discussed further in Chapter X.

POLITICAL FACTORS

Although neither strictly technological nor strictly educational, the factor of political feasibility must be considered in determining the potential uses of a telecommunications system. Political considerations may be organizational, local, statewide, or national.

At the local level, it should be determined whether extensive use of telecommunications technology originating outside the local school district negates in any way the basic principle of local control of the educational process. Should conflicting factions develop within a community the technology could be impeded. In addition, funding provisions at the local level may be non-existent or of very low priority because of pressures to keep taxes down.

At the state level, there are several necessary considerations involving the attitude of the State Board of Education and its members, who are directly responsible to the voters, the Texas Education Agency, teacher organizations, commercial and educational broadcasters, vendors of both textbooks and other software, and, finally, the legislature, which will have to fund any telecommunications undertaking. There is some possibility of factions developing in the course of elections for the Board of Education as candidates take stands either for or against technology, thus polarizing board members in the setting of policy.

Within the Texas Education Agency, the relationship of a telecommunications system and its staff to the total activity of the Agency could be a pivotal political issue. As a system separate and apart, the feasibility of its development appears low; as a vehicle to facilitate the performance of multiple functions by the entire Agency, the possibility of its implementation improves greatly. However, control of the telecommunications system through a given division or office of the Agency may also be a sensitive issue.

Most teacher organizations, whether unions or professional associations, do not appear to have dealt with the question of allowing educational technology to perform various tasks in ways which are different than those which a teacher would use in performing the same tasks, but which result in the same pupil learning. The emphasis by teacher organizations on lower pupil-teacher ratios has potential for hindering the implementation of a telecommunications system because it forces education to remain a highly labor-intensive undertaking, thus negating any cost savings that technology could offer in this area. With the present glut of teachers seeking positions, such a stance is understandable, but it will have to be examined very carefully if a technological system is to be implemented as anything other than a frill, an enrichment, or something "nice to have."

Commercial and educational broadcasters may also need to be courted in order for a telecommunications system to be politically feasible. Should the decision be made to use existing cable facilities, for example, the fact that educational channels must be set aside in some cable markets, whereas other markets are not required to offer such services, could become a touchy issue. Educational broadcasters currently receive a large part of their funding through local school districts, with some coming through the state; will they view a comprehensive telecommunications system as competition for funding and audiences, or can a workable plan incorporate their extant facilities and organizational patterns into the statewide system?

Vendors of textbooks and software must also be considered as a political force. Textbook publishers will undoubtedly be somewhat reluctant to see any changes in the adoption system as it presently exists; yet most of them are already into the production and marketing of multi-media software and thus may see a telecommunications system either as opening new markets or else as closing markets at the district level because of software availability through the system.

A system dependent on legislative funding will, of necessity, have to develop clear objectives as well as a broad base of citizens throughout the state who will support it. Constituents should be made aware that such a system takes time to develop and that it will not result in the instantaneous multiplying of technologies in each school building in the state. A plan for continuing funding rather than biennial appropriations thus seems imperative.

Cognizance should also be taken of the passage by the 64th Legislature in 1975 of S.B. 42, known as the "Public Utility Regulatory Act." This act, which becomes effective January 1, 1976, provides for regulation of public utilities, except gas, by the Public Utility Commission it creates. Specific utilities covered include those with equipment and facilities for

> conveying or transmitting messages or communications by telephone, telegraph, or other electronic means, for compensation, excluding radio or television broadcasting stations as defined in 47 U.S.C.A. Section 153, as amended, and requiring licenses from the Federal Communications Commission pursuant to 47 U.S.C.A. Section 301 and excluding community antenna television systems. (S.B. 42, Article I, Section 3(d)(2))

S.B. 42 also covers computer utilities that are open to the general public for subscription to their services, thus having a potential effect on such activities as home learning systems, and the Commission will have exclusive original jurisdiction over the intrastate business and property of all telecommunications utilities in Texas.

Since changes in rates of a telecommunications utility potentially could have a ripple effect on budgeting for a telecommunications network covering schools throughout the state, the provisions for filing proposed rate changes and for protesting same should be examined, and their interpretation as the Act is implemented should be monitored.

S.B. 42 also states that unnecessary duplication of facilities and capital investment for providing utility service constitute an economic waste not in the public interest. Thus, the bill prohibits public utilities from extending competing services to customers already being served. It provides that the Commission

> shall examine the specific facts of any proposed telecommunication utility service to determine if competition is capable of effectively regulating that particular market. If the commission concludes that competitive market forces would operate in the public interest in a particular market the commission may promulgate rules and regulations prescribing the method and manner of competition to be allowed. (S.B. 42, Article X, Section 63)

Depending upon the distribution method(s) chosen, it appears that any decision to develop a telecommunications network using existing or proposed public utility facilities might result in coping with two regulatory agencies: the Public Utility Commission and the Federal Communications Commission, since such a network would evidently be partially under the jurisdiction of each. Thus, continuing attention to the manner in which the state commission defines its operational role is essential.

At the national level, a prime issue is copyright legislation; until this issue is resolved the software for use in a telecommunications system will remain limited.

A further national consideration involves the amount and type of federal aid to public education: whether the aid will be categorical or in a lump sum to be distributed by the state education agencies, whether its focus will be on materials or on personnel, and the extent to which it will be constrained by the necessity for state compliance with other federal regulations such as those covering affirmative action and equal employment opportunity. Input from congressional constituencies may be a major factor in determining the direction of federal funding and the extent to which it may be used in developing a telecommunications system; input to the Office of Education and to Congress from such lobbyists as teachers, vendors, educational technologists, and librarians must also be considered. Unionization of the personnel associated with the various functions of the system constitutes a further consideration, and one which is discussed at somewhat greater length in the section on Financing and Ownership in this chapter.

ORGANIZATION

General Considerations

Although the primary thrust of this study has been technological, its recommendations cannot be made purely on the basis of technical factors. The derivation of a solution methodology involves the interaction of several key factors, and these in turn must be measured against the criteria developed. A common thread to all proposed solutions, however, must necessarily be the factor of the taxpayers' money. Financing is certainly paramount in determining the amount of technology introduced into any educational system, and its spectre hovers over any decisions involving the optimal educational telecommunications system to be recommended. A parallel factor bearing on these decisions is the method selected for managing the telecommunications resources. With dollars becoming more and more scarce, the optimal organizational pattern becomes critical. After all, we must answer to the public in general--and to parents in particular--in providing the most effective educational system possible within prescribed budgetary limitations.

For the better part of the past decade, the federal government has been heavily involved in applying technology to teaching and learning. The inflationary state of the national economy has sharpened the issue of educational productivity until it is now a primary concern. Costs have risen steeply in this same decade, from $27 billion to operate public and private schools, from kindergarten through college, in 1960-61 to $70 billion in 1970-71 (National Academy of Engineering, 1974). At the same time, the concept of "open" education--open to anyone desiring to learn more either for personal enrichment or for professional advancement--is taking root in this country. Pioneered in Great Britain, the free-access systems now being developed in the United States as well are brave new ventures, launched more on the basis of intuitive conviction than on that of hard data concerning national demand for learning opportunities outside the formal education system. However, there is much evidence, some of it reported in the chapter on telecommunications in other states, that provides strong support for the concept of "open" education. This section is not intended to be a treatise on organization; rather, it is intended to review some organizational patterns currently used in education, and to make some observations that may lead to a recommendation for organization that will enhance the technological conclusions presented.

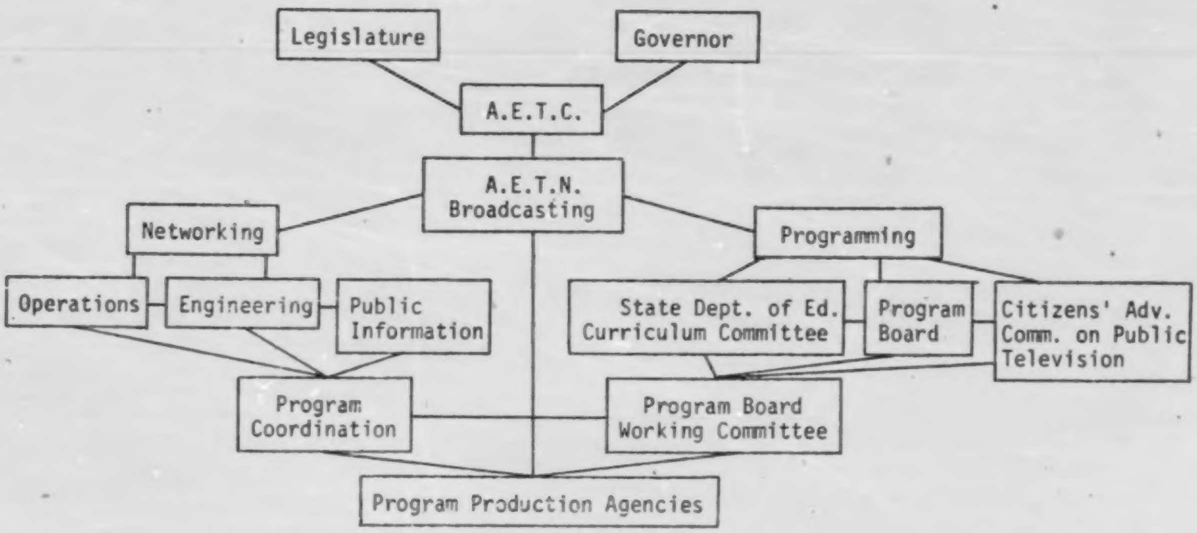
Strategies designed to persuade more people to make informed value judgments concerning technology must take into account human behavioral patterns that show deep-seated resistance to change. In the military services, this factor is offset somewhat by periodic reassignments which have a tendency to prevent stagnation in any given position. However, in a more static system in which there is little opportunity (or desire) to change, any changes made must necessarily be evolutionary in nature. It is doubtful, then, that any organizational changes in the Texas educational system tending toward radical rearrangement will ever meet with widespread favor or success. Accordingly, it is not our intent here to attempt to reorganize this system, but to discuss and suggest means of incorporating newer technology into the present educational organization.

Alabama

In Alabama, educational technology is the responsibility of the Alabama Educational Television Commission (AETC). The AETC manages an educational TV network organized as shown below:

Alabama Educational Television Network

Organizational and Operational Structure

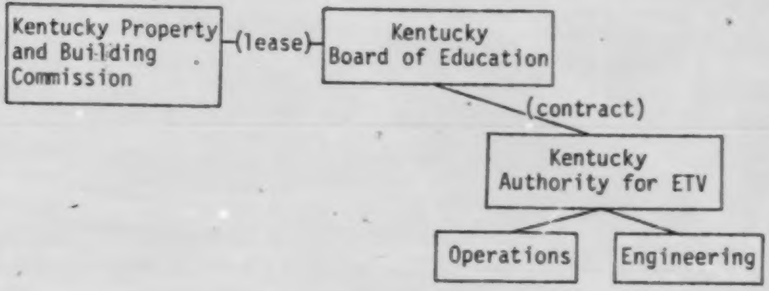

Legislature
Governor
A.E.T.C.
A.E.T.N.
Broadcasting
Networking
Programming
Operations
Engineering
Public Information
State Dept. of Ed. Curriculum Committee
Program Board
Citizens' Adv. Comm. on Public Television
Program Coordination
Program Board Working Committee
Program Production Agencies

The AETC is a "take-charge" commission of five commissioners, appointed by the Governor and approved by the senate. The commission has responsibility for the entire network, including programming, engineering, and public information. The AETN provides state-owned broadcast television facilities that cover 97 percent of the state and are managed by a general manager who has total responsibility for the network. The telecommunications network is shared with other state agencies. There is a Program Board, composed of the heads of the institutions under contract with the AETC to furnish programming for the state network. The Program Board Working Committee consists of administrative assistants appointed by Board members, and has as its purpose research on and establishment of programming guidelines. The Programming Advisory Committee was established by the Commission as a sounding board at the grassroots level; its members, comprising some 30 representatives of significant groups and organizations throughout the state, input their opinions and reactions to state network programming. As can be seen in the above figure, the administration of telecommunications technology has been superimposed on the total educational system of the state without changing the structure of the Department of Education. Of particular note is the placement of all telecommunications facilities in the state under one general manager and under the direct supervision of the AETC.

Kentucky

In Kentucky, the State Board of Education, a "take-charge" agency, leases educational television facilities from the Kentucky Property and Building Commission, a public agency of the Commonwealth, empowered by the General Assembly to issue revenue bonds for the purpose of constructing educational TV facilities. The Kentucky Educational Television Network (KETN) is a state-owned combination multiple channel open circuit (broadcast) and closed circuit television system, with the microwave system leased from the telephone company. The Kentucky Authority for Educational Television, a public agency and instrumentality of the Commonwealth, was established by the General Assembly to operate these facilities by contract with the State Board of Education. In Kentucky, all telecommunications technology has been organized under the Board of Education; however, a parallel to the Alabama system exists in that one agency has complete responsibility for the network.

KETN Structure

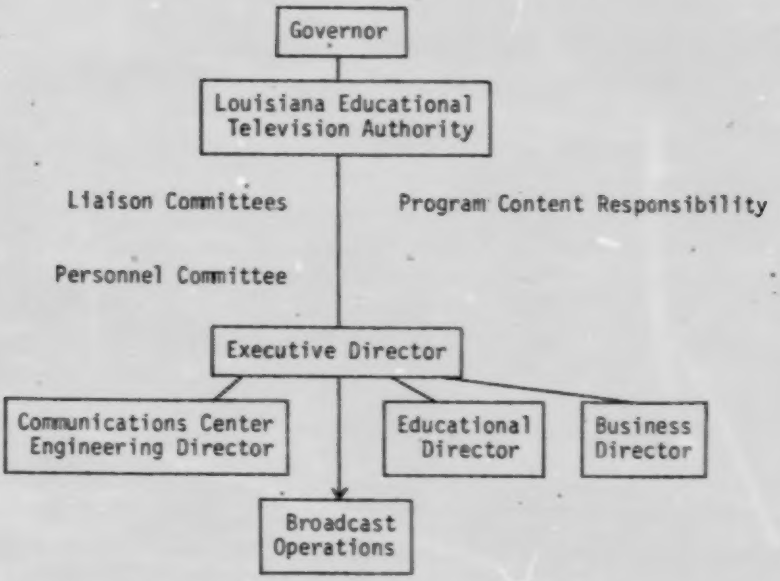

Kentucky Property and Building Commission
(lease)
Kentucky Board of Education
(contract)
Kentucky Authority for ETV
Operations
Engineering

Louisiana

The Louisiana Educational Television Authority (LETA), a "coordinating" agency, is empowered to lease, purchase, construct, own, operate, manage, and be the licensee of educational and public television and radio stations, including existing state agency telecommunications networks. The power to establish policy to carry out its authority is vested in the members of the Authority, which consists of the Governor, the state Superintendent of Education, and the president of the Louisiana State Board of Education, or their designees, and 18 persons appointed by the governor with the advice and consent of the Senate and coming from each congressional district in the state; Louisiana State University and A&M College; the Louisiana Coordinating Council for Higher Education; the presidents, officers or deans of the private colleges and universities; the Louisiana School Board Association; teachers in the public elementary or secondary schools; the Louisiana Association of Broadcasters; the Louisiana Council for Music and Performing Arts; the Department of Hospitals; the Council for the Development of French in Louisiana; and the membership of the Louisiana AFL-CIO. Within this framework, sole responsibility and control are vested in the State Department of Education for the preparation, content, and programming of all instructional television used in elementary and secondary education; in the State Department of Hospitals for all medical instructional TV programs; and in the State Board of Education and the board of supervisors of Louisiana State University for all instructional TV programs used for granting college credits.

Here, again, the technology is divorced from the Board of Education; however, in this case all facets of educational technology (network operations and programming) are organized under one agency, LETA. (See the chart on the following page.)

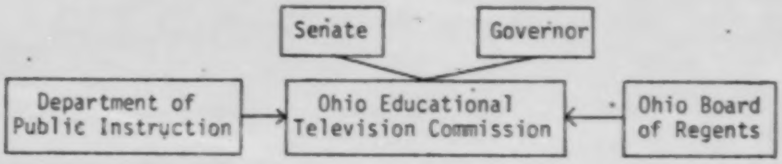
LETA Structure


Governor
Louisiana Educational Television Authority
Liaison Committees
Program Content Responsibility
Personnel Committee
Executive Director
Communications Center Engineering Director
Educational Director
Business Director
Broadcast Operations

Ohio

The Ohio Educational Television Commission (OETC), a coordinating agency, is charged with the responsibility of ensuring the continued growth of educational and informational television in the most efficient and economical way possible. The Ohio educational television stations are all independently operated and funded, so that the primary function of the Commission is one of coordinating the activities of these autonomous stations. The commission consists of 11 members, including nine business and professional leaders appointed by the Governor with the consent of the state Senate, serving four-year staggered terms, and two statutory members: the State Superintendent of Public Instruction (representing elementary and secondary education) and the Chancellor of the Ohio Board of Regents (representing higher education).

OETC Structure


Senate
Governor
Department of Public Instruction
Ohio Educational Television Commission
Ohio Board of Regents

As can be seen in the above figure, the educational technology has again been organized separately from existing educational agencies, leaving these agencies untouched.

Summary

In summary, a comparison of the organizational structuring of educational technology in Alabama, Kentucky, Louisiana, and Ohio reveals striking similarities among all four states. Without exception, a commission has been authorized by the state governing body with responsibility for all educational technology, with representatives from the educational agencies serving as members of the commission. The telecommunications networks established under the authority granted the various commissions have been retained as entities responsible to the commissions, and in two of the states the networks cover all telecommunications requirements of all state agencies. Such an organization would provide, in effect, an evolutionary change within the Texas educational system and would not radically alter existing management structures.

FINANCING AND OWNERSHIP

In Chapter V, various intrastate networks utilizing telecommunications were described in terms of type, size, and cost. While no attempt was made to examine all of these networks with a view toward integrating them into "one total system," a preliminary analysis of the possibilities for financing and ownership for such a hypothetical system must now be considered.

A study of adoption of innovations conducted in New York State (which essentially parallels the examination of possibilities for establishing a large, coordinated information-handling network within the state of Texas) concludes with the following major findings:

(1) Legitimization of the innovation by influential persons within the system must occur prior to its complete installation.

(2) The innovation must demonstrate a comparative advantage over competing activities before it is readily accepted.

(3) Incentives for adoption of the innovation should be evident.

(4) Installation of the innovation should accommodate existing conditions whenever this can be done without limiting its effects.

(5) Persons affected by the innovation should be involved in the decision to accept, reject, or modify it.

(6) Innovations must be of sufficient magnitude to commit the adopting agency to the success of the program. (Hull and Benson, 1972)

This study comprised a survey conducted among 32 cooperating institutions using a questionnaire which was filled out by each ERIC supervisor. (The New York study anticipated an ERIC-based automated information system, and thus the ERIC supervisors at each institution were the persons selected to respond to the questionnaire.) While the guidelines provided by its findings will serve as excellent criteria for justifying the installation of an innovative system, the methods for financing such a system still need to be addressed. Basically, the various techniques for financing any statewide system are as follows:

(1) Through state appropriated funds. The majority of telecommunications networks are funded through state appropriations only. The funds may either comprise a one-time appropriation or be granted on a recurring (line item) basis which is adjusted according to rate of usage and/or growth prediction.

In Texas, budgets are prepared on a basis of biennium funding and implemented in the various state agencies accordingly. However, such factors as inflation, excessive rate of growth, underestimating of traffic, tariff rates, and increases in cost tend to negate accurate budget forecasts over this long time period. Yearly fund allocations have the advantage of adjusting to actual costs; however, initial operating funds must still be established.

(2) Through matching federal funds. These are generally support funds which are related to national federal research programs. They normally require a considerable

commitment to federal guidelines on the part of the state and may extend for longer than one or two years.

(3) Through state special bond issue. This type of financing is normally used for building construction and falls into the category of long-range financing as part of a comprehensive plan.

(4) Through state-owned subsidiary corporations. There are wholly state-owned subsidiary corporations which are run by a self-supporting sales or service type of operation. These are mainly utility-oriented, although they may include, in some special cases, companies with educational objectives.

(5) Through private foundations and philanthropic agencies. In many instances, a state may obtain funds from private foundations such as Ford, Carnegie, Guggenheim, Exxon, Moody, Clayton, etc., for buildings, equipment, or research for public education. It is not inconceivable that such coverage could extend to the use of newer technologies, such as satellite ground stations for providing educational services to remote areas. Foundations normally require some matching funds from the grantee; this varies with the type of grant award.

A combination of two or more of the above methods could conceivably be used within a state. Another method of financing which is not described above and which requires participation by one or more states is consortium funding: the banding together of several states to fund, for example, a satellite delivery system dedicated to educational applications. This method may or may not include federal agencies, but must be considered among the alternatives for financing and cost-sharing.

In the financing of a statewide educational telecommunications system, assuming that funding were determined, several other points would have to be clarified concerning ownership and regulation. Ownership may comprise state purchase of all equipment with state-appointed personnel having inhouse responsibility for operation and maintenance within either a centralized or a decentralized organization; or it may involve a lease agreement for services or a contract for operation and maintenance on a "turnkey" basis. A brief mention of the advantages and disadvantages of each strategy follows:

Advantages of State Ownership

(1) It allows for complete control of the system and freedom to operate it, within the constraints of regulatory legislation; and it allows for improvement and updating of the system as required to be more responsive to the needs of the user.

(2) The apparent costs are generally less than those of a lease system, based upon an amortization period of ten years or more for system payout.

(3) It allows for centralized, efficient systemwide operation.

Disadvantages of State Ownership

(1) It requires a heavy initial outlay of capital for plant, buildings, and spare parts.

(2) It requires the recruitment and training of highly skilled technical/engineering personnel, resulting in high additional costs for state manpower.

(3) It places the state in competition with private/commercial companies.

(4) It cannot guarantee efficient, full system utilization.

(5) It involves hidden costs of an increasing permanent, bureaucratic overhead.

Advantages of State Leased or Contracted Services, Equipment, or Facilities

(1) Capital investment for equipment is low under a leasing arrangement.

(2) The problem of obsolescence is minimized.

(3) The question of responsibility for maintenance and operation of the system is simplified.

(4) Minimal augmentation of supervision and of manpower is required on the part of the state.

(5) It invites competitive bidding.

Disadvantages of Leasing Arrangements

(1) Cost control cannot be guaranteed, as overruns for unanticipated costs can exceed the budget despite contractual agreements.

(2) There is a lack of direct supervisory control of system operations and maintenance.

(3) There is little or no flexibility in adjusting to the fluctuating needs of major users of the system, i.e., loading balance.

Regulatory Aspects

The Federal Communications Commission regulations apply to telecommunications systems whether owned by the state or by a common carrier. In either case, a group of specialists must be formed to administer regulations, gather report data, and assure compliance with the detailed, complex, and ever-changing regulations.

Costing Out a System

The decision as to whether it is cheaper to own or to lease a system can be made in the context analysis or planning stage by taking into account the following cost elements:

(1)	System acquisition costs, based on 5-year amortization	costs/year = annual costs
(2)	System maintenance costs, @ 7.66% of cost of acquisition, per year	yearly maintenance costs
(3)	Software costs, based upon 5-year amortization	software costs/year
(4)	Staffing costs per year, based on number of personnel times number of years	total personnel costs/year

The sum of the four annual cost items represents the cost side of the cost-benefit fraction. The benefit side is usually represented by total student hours, so that when the fraction is reduced, the resulting unit indicates cost per student hour. Estimators must remember to deduct all idle time for the computer, including night time, and weekend and summertime non-use, if any.

A specific example of costing out a computer system for use with computer-assisted instruction is given in the table on the following page, developed by the Hewlett-Packard Corporation for the HP-2000F #205 instructional system.

THE OPERATIONAL COST OF CAI*

HP-2000F #205 Instructional System

65000 Char. Central Processor
16000 Char. Communications Processor
9 Track/800 CPI Tape Drive
23.5 Million Char. Disc Storage Unit
Systems Console, High Speed Tape Reader, Cabinets

Supports 32 simultaneous users for Computer-Aided Instruction, Problem Solving (User Programming), and Packaged Applications.

COSTS:

Computer System:	
Purchase Price, Approximately $90,000	
Annual Cost (5-Year Amortization of Purchase)	$18,000
Computer System Maintenance:	
Approximate Annual Cost ($575/month x 12 months)	6,900
Proprietary Software:	
One-time Leasing Charge, Approximately $5,500	
Annual Cost (5-Year Amortization)	1,100
Terminals: (ASR-38, Hardwired)	
Purchase Price, Approximately $1,500/Terminal	
32 Terminals = $48,000	
Annual Cost (5-Year Amortization of Purchase)	9,600
Terminal Maintenance:	
Approximate Annual Cost ($25/month/terminal x 12 months x 32 terminals)	9,600
Staffing:	
One Professional (½ Time)	10,000
Two Part-Time Student Assistants	8,000
TOTAL ANNUAL COSTS	$63,200

COST PER TERMINAL HOUR

(Based on Total Annual Operational Costs of $63,200)

	Hours/Day of 32 Terminal Usage							
Days/Year	8	10	12	14	16	18	20	22
180	1.37	1.10	0.91	0.78	0.69	0.61	0.55	0.50
200	1.23	0.99	0.82	0.71	0.62	0.55	0.49	0.45
220	1.12	0.90	0.75	0.64	0.56	0.50	0.45	0.41
240	1.03	0.82	0.69	0.59	0.51	0.46	0.41	0.37
260	0.95	0.76	0.63	0.54	0.47	0.42	0.38	0.35
280	0.88	0.71	0.59	0.50	0.44	0.39	0.35	0.32
300	0.82	0.66	0.55	0.47	0.41	0.37	0.33	0.30
320	0.77	0.62	0.51	0.44	0.39	0.34	0.31	0.28
340	0.73	0.58	0.48	0.41	0.36	0.32	0.29	0.26
360	0.69	0.55	0.46	0.39	0.34	0.30	0.27	0.25

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*From Hewlett-Packard (Cupertino, California: Hewlett-Packard Data Systems, 1974).

Table IX-a

The Question of Unionization

Another possible factor in the overall consideration of lease vs. ownership of a statewide telecommunications system is that of unionization within the communications field. It could be argued, for instance, that reliance on a privately-owned system whose employees were unionized could endanger the smooth operation of the system if and when such employees went on strike and that for this reason Texas should perhaps seek state control and ownership of such facilities. Although unionization does appear at first glance to be a major factor here, examination of the current situation in Texas indicates that strikes within private corporations are not that likely.

Certain support function organizations are presently unionized (such as the United Communication Workers of America, contracted with Bell Telephone, and various unions within the transportation fields--railroads, air freight, etc.), but many other companies, such as IBM, which would perform the highly technical and managerial functions involved in running a state telecommunications system are not unionized and are not likely to be any time soon because the companies themselves presently provide quite adequate benefits to their employees and there is no real impetus to unionize. Although those organizations that provide support to the hardware suppliers would also have to be relied upon by the state, the real issue here is not whether strikes within the support companies could be averted by a state-owned system, but whether the eventual likelihood of strikes within the telecommunications system itself would be reduced by a state-owned system.

As the state law presently stands, civil servants cannot legally strike and, if they do indeed strike illegally, they can be fired. Additionally, the only public servants who can bargain collectively (without striking) are certain groups of policemen and firemen within municipalities (or other political districts, such as counties) which have (through local option elections) approved the state law guaranteeing such rights to bargain collectively. Efforts to "unionize" the civil service system in Texas are currently not well organized, and legislation approving collective bargaining for all civil servants is not likely to come in the near future; however, within the past 15 years, most of the growth of unions nationwide has been in the public sector and the possibility still remains that state employees ultimately may be organized.

Thus, although unionization may be a minor consideration in the overall decision as to whether the state should lease or own a statewide telecommunications system, the advantages of private management of such a system probably outweigh the remote chance that strikes would disrupt its smooth functioning. A private company would maintain equipment, so that the state would not have to provide constant in-service training for maintenance personnel, and such a company would update the equipment and be responsible for any malfunctions that might occur.

However, the pros and cons of using union personnel vs. using civil servants are so subject to change that they will not be discussed here in greater detail, and the question should be analyzed further in any future plans for a statewide system.

POTENTIALITY

A careful review of the foregoing narrative indicates that there are several options with varying degrees of potential for educational achievement. This is exactly the case. The real problem is that of meeting local needs with methods that will neither fall short nor obsolesce and yet will not cost a king's ransom.

Further careful analysis is necessary, and this is provided in the next chapter as a lead-in to the conclusions that are drawn there.

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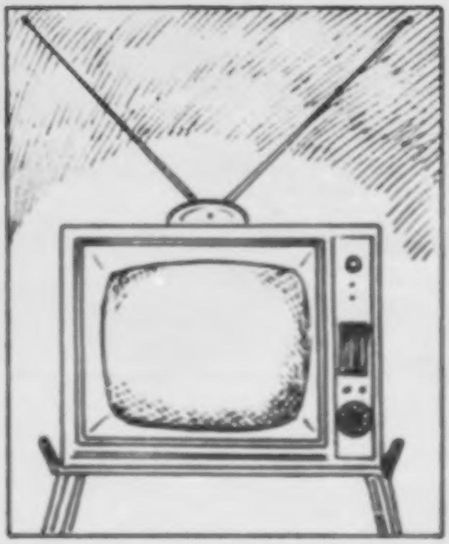
conclusions X



PRÉCIS

Analysis of all the data and information gathered, assessment of possible alternatives, and application of the objectives and criteria lead to our specific findings and conclusions. This portion of the report begins with a discussion of three broad topics: technique of analysis, diversity of source of findings, and the multiform nature of the conclusions (which have several levels of significance).

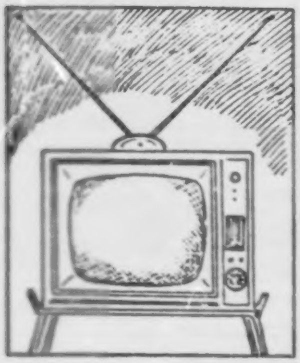
This is followed by presentation and discussion of conclusions in specific areas of activity: technology, financial (and ownership), organization, political, human, and strategy, respectively. In each of these areas, there is a discussion of relevant points followed by the enumeration of specific conclusions.

The last major section establishes that the conclusions have certain characteristics: they involve technologies which are forward-looking, long-lasting, compatible, non-disruptive, comparatively inexpensive, and flexible, and which embody the element of participation and facilitate individualization.

The main thrust of the conclusions is that education would best be served by the expansion of an already extensive cable TV network (CATV) to almost all school campuses; that the same network can provide narrowband channels for data transfer and for CAI/CMI; that such a combination could provide the greatest opportunity and flexibility for the least cost; and that all the programs of the Instructional Resources System would be served by such a system.

Major components of this chapter are:

Discussion p. X-1
Specifics p. X-1
    Technology p. X-1
    Financial p. X-4
    Organization p. X-4
    Political p. X-5
    Human p. X-6
    Strategy p. X-7
Overall p. X-9
Bibliography p. X-10



X

FINDINGS AND CONCLUSIONS

DISCUSSION

Technique

Although this does not constitute a conclusion *within* the study, but rather one *about* the study, we now realize, with hindsight, that we *have* used the Delphi Conference methodology in sharpening the focus and narrowing the scope to point to specific possible solutions. The Delphi Conference is similar to the general Delphi technique, which utilizes correspondence, except that in the conference method the elapsed time required can be shortened, and there is direct interaction between the persons involved. (In the standard Delphi process, such interaction normally does not exist.) The conference method has some other advantages as well: it provides a relatively equal flow of information to and from all participants; it can minimize adverse psychological effects through discussion of problems and subsequent alleviation of fears; and it allows conferees to participate for longer or shorter periods of time according to their individual requirements. However, although it may sound like one, it is not the same as a committee meeting by any means, and should not be so considered. We realize now that we have used the Delphi Conference technique for the latter portions of this study, although we did not specifically intend to do so, and that we have progressed with reasonable agility to amend our thinking on the basis of the discussions and interactions that evolved. (Turoff, 1971)

Diversity

The preceding chapters make certain specific points; in addition, summaries, implications, and even some definite conclusions are presented. There is no easy way to bring all these various points together, because even those that are fairly evident in themselves may not relate clearly to others, and the overall conclusions may necessarily vary from those of any one chapter. In the rest of this chapter, then, we will present those broad conclusions that we can draw from material anywhere in the report, as integrated with other information.

Nature of the Conclusions

We further realize that the conclusions we can draw are not all at the same level, nor necessarily of the same consequence. Many of them are subsidiary to, or interlocking with, others. Having drawn our tentative conclusions, we see the need to reorganize the methodology and the order of their presentation to make them more logical and more readily understandable; thus, the sequence in which they are stated here is not that in which they were actually formulated.

SPECIFICS

Technology

General trends. As can be seen from the foregoing material, a strong tendency presently exists to direct instructional technology into the realm of the audiovisual, including television, motion pictures, and other audiovisual technologies that are eminently successful in conveying information and ideas to students. As a secondary point, there is a strong and growing trend toward the use of computers, both for management and for instruction. The use of computers in certain kinds of instruction may be limited, but in those areas where it actually is useful it is proving to be very successful. So, it is slowly gaining acceptance and broadening the areas in which it can be used. In addition to these two techniques, audiovisual wideband presentation and computer-assisted/computer-managed instruction, there are several kinds of terminal equipment for display and instruction which are also becoming more accepted.

The video cassette is obviously coming into wider use, and it will be followed rapidly by the video disc. In the field of computer technology, there are not only keyboards similar to a teletype, but usually cathode ray tubes and very frequently audio transmitting devices, either tape or disc, that can provide a verbal analogy to the presentation on the picture tube. Almost all of the devices now coming into use are moving away from the paper print-out type of teletype materials and going toward visual displays with light pens and other forms of machine responses that are both audio and visual.

Considering the relatively high density of commercial CATV in Texas (see map on p. V-20), it can be concluded that the extension of this service to all of the cities, towns, and villages in Texas would be relatively inexpensive. Possibly the CATV delivery systems could be encouraged to extend their service at their own financial risk, or possibly the state could subsidize this in part in order to guarantee extension to all school buildings. This done, wideband television channels would be provided in sufficient quantity to every school building in the state. Insofar as the large cities are concerned, where CATV is not now available, a recent change in FCC regulations permits the installation of cable television in these cities provided that certain channels are made available for educational use, which would give the entire state an adequate network. Since every CATV system can provide up to 35 wideband channels, a number of these could be reserved for educational use by the state and could be linked into statewide or regional networks.

Any one wideband channel can be multiplexed to provide several narrowband channels, which would permit audio transmission, teletype transmission, and, most significantly, computer transmission with a number of channels operating simultaneously, so that different courses could be provided to different schools at the same time. It would be necessary, of course, to provide suitable terminal equipment in whatever quantity were deemed feasible to each campus. However, the primary advantage of such a system would be that it would assure the availability of interactive television, computer-assisted instruction, and computer-managed instruction, offering a close approximation to what apparently is slowly developing in terms of the home learning center. Thus, the ability to use the same techniques and the same software both at home and in the school appears not only possible but probable.

Management. There seems to be no question but that, wherever feasible, management information is being handled in Texas on an automated basis, with computer centers located at several places within the state. Various school districts and education service centers are satellited on these computers and are obtaining service from them. Thus, the availability of computerized instruction in several locations will provide the opportunity for still further improvement of management systems throughout the state, while following existing acoustic techniques and directions without disruption. The flow of information from schools to districts to regions to the Capitol should proceed in logical, systematic fashion, and more information should reach decision-makers faster than has previously been the case. Similarly, with regard to distribution, comprehensive statistical analyses of information can be distributed rapidly and widely to the levels where it is needed for comparison with and understanding of local statistics.

Dissemination. Another program of the Instructional Resources System comprises the adoption of appropriate technologies and the dissemination of information about these and other technologies statewide, so that decision-makers at all levels can know what is presently available, what ongoing research is in the process of discovering, how well new technologies are working, what other people are doing, and what the prospects are for the future, so that they can use this information in their own planning. An automated information network such as the one described here as being appropriate for instructional purposes would also be appropriate for dissemination of technological information, as this information could be computerized, automated, and distributed on a statewide basis according to specifically expressed needs, thus satisfying the overall requirements of the Instructional Resources System.

Similarly, other educational information could be distributed through the same channels. For example, a system such as the Texas Information System (TIS) could operate over such a network, and teleprinter-type distribution of ERIC searches, new information released, or other materials appropriate for dissemination could be made to and from all stations.

Whatever successes education may have enjoyed in the past few years, rapid and efficient dissemination and diffusion do not constitute one of them. Further study and testing would be not only appropriate but probably imperative before undertaking any further dissemination efforts in Texas.

National nets. It is not possible to say at this time that national educational nets will ever be established, or, if they are, to indicate exactly what they will comprise. However, there is no question but that those national communication nets presently existing, such as ARPA and those belonging to the military services and various other users, are all based on computer management and dissemination, and it is most likely that if a national educational net is formed it will have a similar base. Thus, if Texas already has such a system in existence, it has the best possible opportunity for becoming part of a national net and possibly for being one of its initiators.

Software. As can be seen from a review of the chapter on software, there are still several obstacles to the full utilization of educational software on a district-wide or even regional basis, including restrictions on copyright, duplication, etc. However, these restrictions seem to be loosening and it is likely that, if a prime contractor can be obtained who will do some of the systems engineering work and provide some of the hardware, such a contractor could also provide software for more than just local use. This software, in addition to being suitable for widespread use, would also be up-to-date, adaptable, and flexible. In any case, the availability of software for computer use and for television replay is increasing rapidly, and in another few years there should be a fairly complete set of software for all subjects at all grade levels.

Technology summary. The following findings and conclusions may be stated:

(1) That there seems to be little advantage in expanding broadcast television, since other delivery systems for the same materials are cheaper, more flexible, and more efficient.

(2) That commercial CATV networks and delivery systems now blanket Texas, even in heavily populated areas, and that it would be relatively inexpensive to extend these to all towns and schools and amalgamate them into a comprehensive system.

(3) That such a CATV system could provide network, regional, and local programming.

(4) That channels in such a system could also be leased for educational purposes other than television; they could be multiplexed to provide many narrowband channels to be used for voice, data transfer, teletype, computer-assisted/computer-managed instruction, and other audio and digital services.

(5) That several types of terminal facilities (video cassettes, teleprinters, TV receivers, TV projection) could be used with such a system, with this decision left up to local authorities.

(6) That both the audiovisual and the computerized programs could be managed at local, district, or regional levels.

(7) That the management information network of the Texas Education Agency now provides some initiation of the CAI/CMI methodology, and that the additional regional expansion seems warranted.

(8) That a combination of audiovisual programs with CAI/CMI as the instructional technology and CATV as the primary delivery system meets all the basic objectives established for a telecommunications system, as well as scoring highest on the various technological criteria.

(9) That study and testing of methodologies for technological dissemination and diffusion seem warranted.

Financial and Ownership

General. There is a real need to establish a statewide, cost-effective, educationally-oriente telecommunications network to serve as:

(1) A mechanism for the dissemination of video-related instructional matter (live TV programs, video tapes, video cassettes, video discs, etc.);

(2) A computer-linked network for remote access terminals using interactive techniques (computer-managed instruction, etc.);

(3) A management and information handling network to tie in major school districts and education service centers, with a wide variety of administrative, management, and instructional (learning resource center) materials being handled on the same network

The policy and the strategies for the financing, implementation, operation and maintenance of such a network must be left for the State legislature to decide on the basis of recommendations from the Texas Education Agency, subordinate agencies, and school districts. Logically, any large-scale commitment and/or long-range plan must begin with the type of operation now carried on by the decentralized, autonomous education service centers.

To the maximum degree possible, the state must subsidize any new system, whether it is CATV or anything else, although it should attempt to split the costs with local school districts wherever practical.

Financial summary. The following conclusions may be made:

(1) That the greatest potential for the establishment of a statewide wideband telecommunications network at minimal cost lies in the use of the existing intra-state, independent, commercial CATV systems, which could be maximally expanded through limited state subsidization inducements.

(2) That commercial (leased) operation is probably the most efficient and least costly method of establishing and operating a telecommunications network, with cost sharing between the state and local school districts on the basis of a mutually agreed-upon formula.

(3) That the technical guidelines for design of such a telecommunications system must be generated by local users and by state educational agencies on a coordinated and evolutionary basis, with options for changing and updating the technologies as the system grows.

Organization

General. In recent years, the federal government has been increasingly concerned that funds directed toward specific targets within states and cities be used intelligently and effectively. As an indication of this concern, Section 1202 of the Higher Education Amendments of

1972 calls for the creation of state planning groups to coordinate programs and fund allocations, particularly in the overlapping areas of vocational, adult, and career education.

A logical extension of this state planning philosophy, which adheres to the principle of local participation and responsibility, would be the creation of a state council (or commission) of educational technology. Such a council would have as its primary activities coordination and stimulation of the application of educational technology to all educational activities in the state where this would be efficacious. Specifically, it would provide policy and systems studies; make surveys of educational technology activities throughout the state; inventory resources; facilitate development of course work; provide for teacher training; perform research on and evaluation of applications of educational technology; be responsible for dissemination of technological information; and recommend demonstration projects. The council would be composed of members of the public; members of the educational community, including teachers and administrators; and professionals from the areas of educational research, design, planning, and evaluation. In a recent study, the National Academy of Engineering recommended the formation of several related agencies and mechanisms, at both federal and state levels, as shown in Figures X-A and X-B. (National Academy of Engineering, 1974)

A working example of such a council can be found in the Minnesota Educational Computer Consortium, an organization formed by a Joint Powers agreement between (1) the Community College System, Department of Administration, Department of Education, State College System, and (2) the University of Minnesota System. Additionally, previous sections of this report have indicated that the systems of educational technology in Alabama, Kentucky, Louisiana, and Ohio are all organized in remarkably similar fashion, in that they are assigned to commissions (councils) having organizational responsibilities and memberships which closely resemble those previously described; and the telecommunications networks of these states have been placed under the control of these commissions, giving the commissions total responsibility for educational technology.

Organizational summary. The following conclusions are apparent:

(1) That the establishment of a state council (or commission) for educational technology in Texas has great merit and would permit the establishment of authority and responsibility with regard to existing and projected educational technologies. Council authority and support would extend down to the learning resource centers at the campus level, as well as intermediate levels; the council would be responsible to the State Board of Education.

(2) That the various educational telecommunications networks currently extant within the state be incorporated into one coordinated operation and placed under the responsibility of one state agency, reporting directly to the council previously described. (It should be noted that the framework for just such a network presently exists within the Telecommunications Services Division, Board of Control.)

(3) That local and regional responsibilities be delegated as logical and appropriate, depending on the integration of technologies and multi-system usage that is planned.

Political

General. Political factors which demand consideration in implementation of the use of TV, video recordings, computer-aided learning, and information transmission/dissemination fall basically into three areas: (1) existing legislation and political realities; (2) dissemination and interpretation of information concerning the proposed telecommunications services to a diverse number of influential groups and persons; and (3) persuasive communication with those persons and groups who are in positions to influence the decision-makers.

It is obvious that unless a system of educational technology has the support of both legislative and executive officials at the top levels of state government, it cannot be implemented,

RELATIVE STRUCTURE OF
PROPOSED POLICY MAKING AND EVALUATING
MECHANISMS*

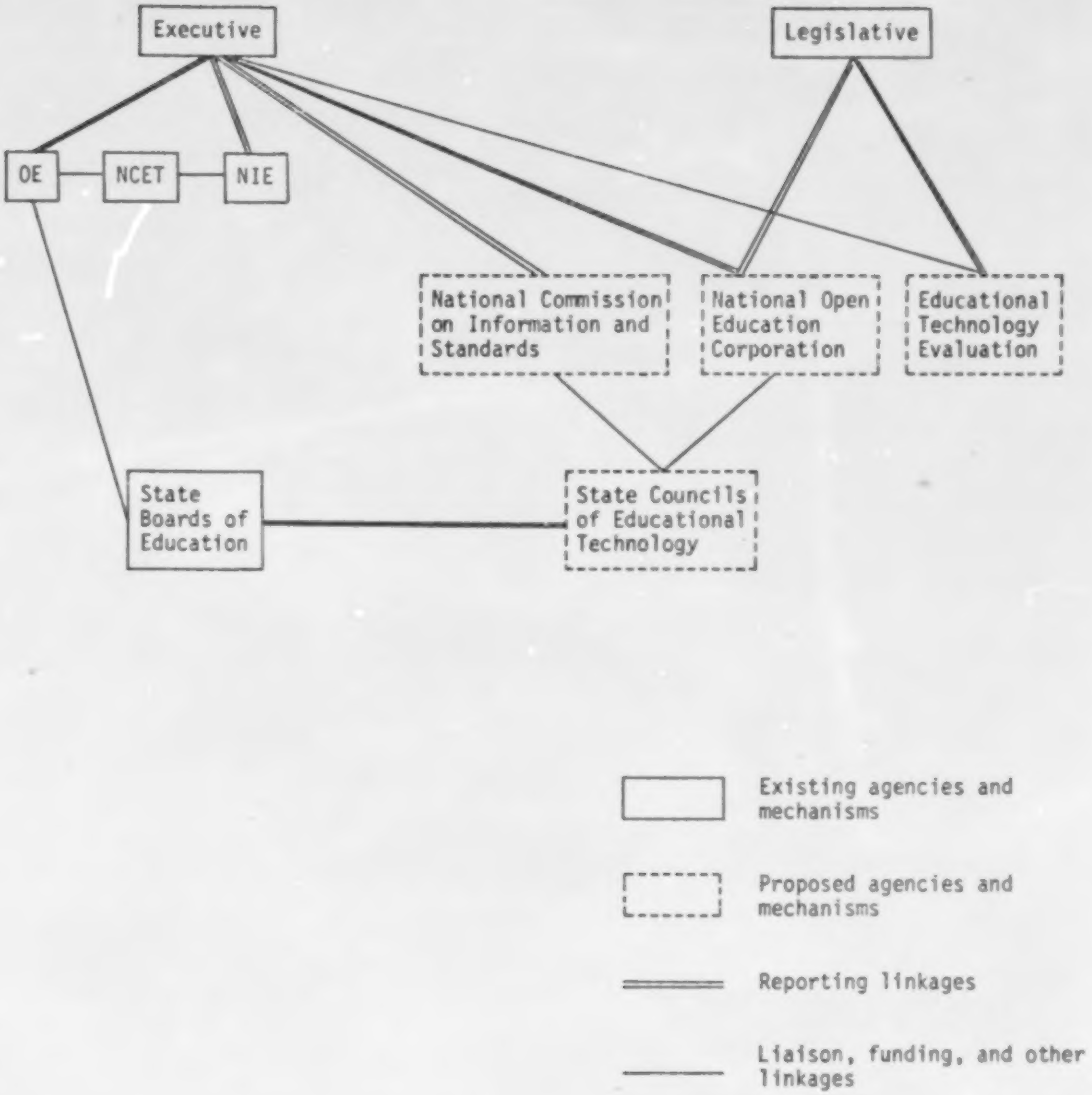

Executive
Legislative
OE
NCET
NIE
National Commission on Information and Standards
National Open Education Corporation
Educational Technology Evaluation
State Boards of Education
State Councils of Educational Technology
Existing agencies and mechanisms
Proposed agencies and mechanisms
Reporting linkages
Liaison, funding, and other linkages

Figure X-A

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*Taken from National Academy of Engineering, Commission on Education, Advisory Committee of Issues in Educational Technology, Issues and Public Policies in Educational Technology (Lexington, Massachusetts: Lexington Books, D. C. Heath and Company, 1974), p. 35.

INTERRELATIONS OF PROPOSED AND EXISTING AGENCIES*

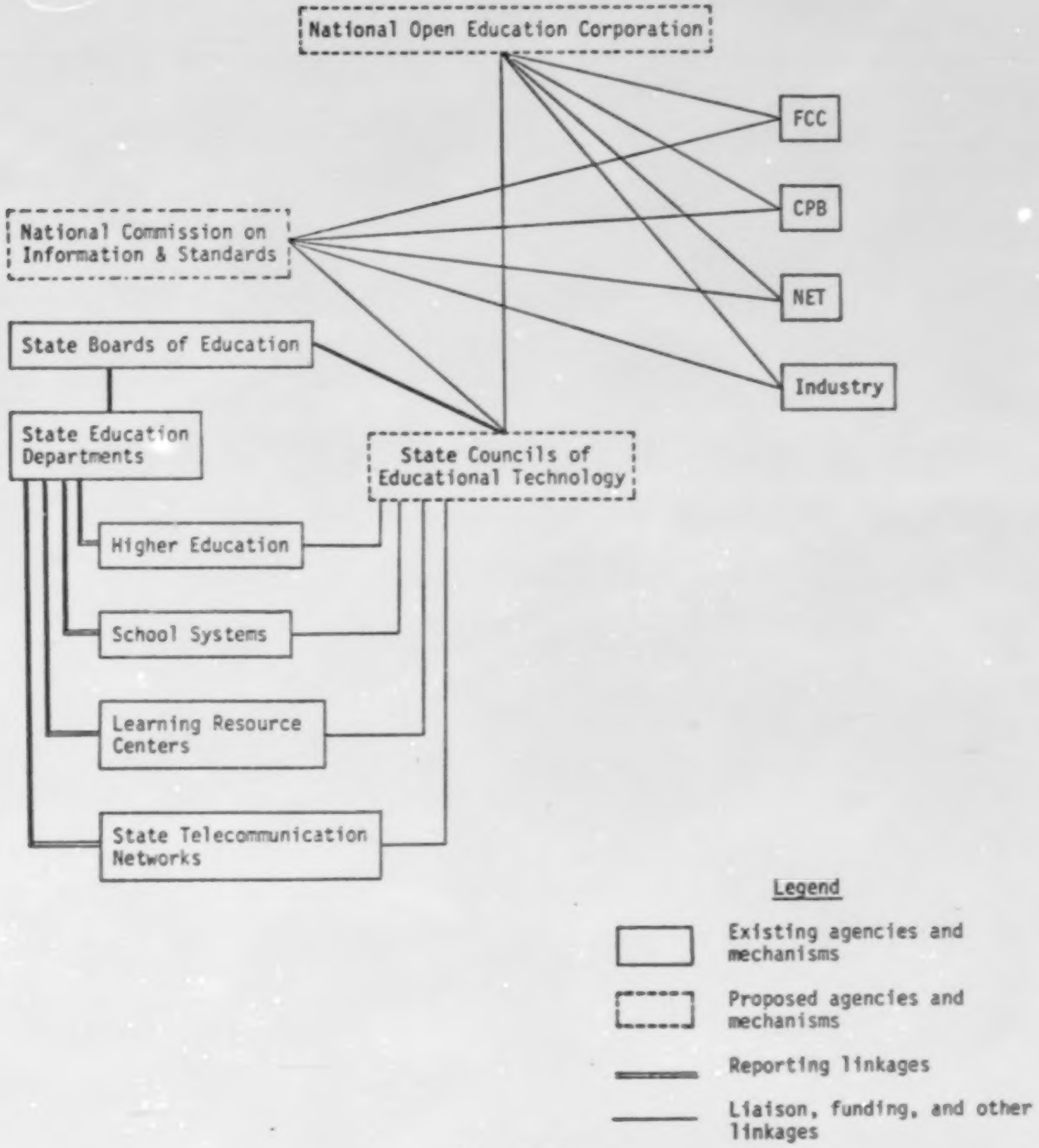
National Open Education Corporation
National Commission on Information & Standards
FCC
CPB
NET
Industry
State Boards of Education
State Education Departments
State Councils of Educational Technology
Higher Education
School Systems
Learning Resource Centers
State Telecommunication Networks
Legend
Existing agencies and mechanisms
Proposed agencies and mechanisms
Reporting linkages
Liaison, funding, and other linkages

Figure X-8

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*Taken from National Academy of Engineering, Commission on Education, Advisory Committee of Issues in Educational Technology, Issues and Public Policies in Educational Technology (Lexington, Massachusetts: Lexington Books, D. C. Heath and Company, 1974), p. 36.

either from the standpoint of financing or that of the human factors involved. Care must be taken to identify objectives in a way that will highlight the educational excellence such a system could provide and to define the parameters of its operations so as not to interfere with or impinge upon existing information offices and regulating authorities.

Since governmental offices are especially sensitive to a wide variety of constituents, careful planning is essential to gain the support of various constituencies who may, in turn, support the system to their elected officials. These constituencies include education service centers; colleges and universities; individual school districts, espeically those serving major population areas; state board of education members; professional associations and unions; and the vendors/producers who would supply equipment and software for such a system as well as those currently competing for textbook adoptions.

In some communities, the issue of local vs. statewide control of content and methodology may be a potential issue. Among many potential supporters of the system, it may be necessary to overcome a distrust of technology and a reluctance to use it because of its potential for decreasing the amount of human interaction that takes place within the schools. Parents, teachers, and administrators (all of whom are also voters) should be led to see that the nature of personal interactions may change as a result of using technology and that their quality actually may improve.

If and when it is possible to overcome most of the problems of orientation to the concept of telecommunications, to indicate its potential for improving learning, and to provide assurances that it will not result in dehumanization, further major political considerations are related to funding--an indication of degree of commitment as well as of the realities of priorities in the use of available monies throughout state government.

Thorough planning for interpretation of the system, for public relations functions, and for activities to gain support is essential.

Summary. These conclusions may be stated with regard to political considerations:

(1) That a planned program of dissemination and interpretation of information to all potential supporters of the proposed telecommunications system is an essential element in its initiation and continuing operation.

(2) That objectives of the system should be carefully stated and articulation of the system with other state agencies and their systems should be defined before soliciting the support of persons and groups who are in a position to influence the decision-makers and funding sources.

(3) That grassroots support from the multiple constituencies whose schools will be served by the system is also essential and must be sought.

Human

General. As previously discussed, all human beings have an innate reluctance to accept sudden or major change, and thus any innovation must be carefully planned out and presented gradually in increments of reasonable size. The implementation of the Texas Instructional Resources System and of the subsystem of new and expanded telecommunications technology which will accompany it cannot take place all at once; it must occur in measurable steps and phases, some simultaneous, some overlapping, and some sequential, and it must include provisions for adequate preparation of all the persons who are to be involved. Such preparation will not comprise a one-time training course, but a comprehensive and continuing effort, and one which must be scheduled to coincide with and complement the installation and implementation of the technologies themselves.

Since the introduction of some of the more sophisticated technological innovations into public elementary and secondary schools on a statewide basis will require the assistance of trained specialists if these innovations are to be used effectively, provision will have to be made at an early stage of development for identification of the specific competencies which will be required, certification of personnel possessing these competencies, and accreditation of institutions in which they can be trained. Guidelines will need to be devised which are compatible with existing certification and accreditation procedures, and curricular units will need to be developed to fit into or to supplement ongoing educational training programs.

Training in the use of the newer technologies will be necessary not only for the specialists who will assist schools in their implementation, but, on a lower level, for all the teachers who must work with them on a daily basis. Thus, all teacher training programs must begin to include components structured to give students a basic understanding of the nature and potential of the various technologies, as well as some basic competencies with regard to their actual use. Not all the necessary training can take place via academic programs, and other methods must be devised for imparting it to school staffs. Special institutes, seminars, and workshops are possibilities for both pre-service and in-service training, as are lectures and demonstrations by highly qualified specialists. Finally, in the case of Texas, it would be appropriate for the Regional Education Service Centers to assume a major role in providing technological information and assistance, and perhaps in sponsoring a number of organized learning activities for teachers and administrators.

Summary. In conclusion, the following statements may be made:

(1) That guidelines for training of technology specialists must be developed which are compatible with existing state certification procedures and national rules for accreditation of training institutions.

(2) That curricular units teaching the effective use of innovative educational technology must be developed for incorporation into the ongoing programs of teacher training institutions within the state.

(3) That provisions must be made for continuing, in-service teacher training in the use of innovative technology.

Strategy

General. As stated in the previous chapter, one major educational goal is to provide equal opportunity to all pupils within the state. Of course, educational goals for Texas are not limited to this. State goals and objectives should be comprehensive and universal in that they should reflect future considerations and longer-term goals for education in Texas. Additionally, such goals and objectives should be publisned, disseminated, and distributed throughout the state so that all administrators can understand and concur with them.

After goals and objectives are well-established and well-defined, it is possible to proceed to the development of an overall solution strategy which should include provisions for meeting the various objectives and should be flexible enough to withstand any changes in the political temper of the country or the state. Contingency strategies should accompany this overall strategy, and, again, such strategies should be made known to all involved in the implementation process.

In this case, it has been concluded that educational technology can serve Texas adequately and, in fact, can provide answers to many of the problems now facing the state in the areas of organization and curriculum. It is apparent that establishment of a statewide system of educational technology would provide a certain uniformity and therefore help equalize opportunity of education for all students. Provisions could, however, be made for local control of individual curricula to meet specific software requirements. The individualization of attention received by students under such a system would contribute to an increase in the efficiency of the entire educational system. And, finally, the system could provide a mechanism for continuing education of adults as well as channels for citizen feedback and participation.

After the realization that educational technology can indeed provide Texas with a solution to many of its educational problems, it is then necessary to decide which technologies will best meet the collective and individual requirements of different factions in the state. Specific details of the implementation of the solution strategy, however, should be worked out on the basis of the technology which is ultimately selected.

After the technology system to be used in Texas has been decided upon, it is then necessary to make provisions for the organization and funding of such a structure. As it presently stands, Texas has a relatively well-defined educational system, under the auspices of the Texas Education Agency, the Regional Education Service Centers, various independent and consolidated school districts, school boards, and the schools themselves. Since such a structure already exists, with some funding already allocated, it would probably be most acceptable to fit the plans for the proposed system of educational technology into this structure, with only minor modifications. Specific structural suggestions have been presented earlier in this chapter under the heading "Organization." An additional consideration at this point, paralleling the development of the organizational structure, is that of providing a timetable or schedule for implementation of the technology.

Funding for implementation of specific educational technologies for operation and maintenance of the entire system can come ultimately from private sources (foundations, etc.) or from state and/or federal monies. Additionally, some money for maintenance and provision of additional software could come from local funds, but it can be assumed that funds coming from such sources will be somewhat negligible (cf. results of the needs survey) and it is probably wise not to rely to any great extent upon local coffers for funding. In the process of developing a plan for funding, specific budgets and schedules should be devised and figured. This would include an examination of maintenance, personnel, and supply requirements, as well as other operational items. Drumming up support for the educational technology system is closely tied to funding, and it is necessary to open the lines of communication in all directions early in the course of the implementation process. Provision of such lines of communication for feedback from citizens and local administrators and for education of the citizenry of Texas concerning the proposed plan for educational technology should also provide a route for the continuing dissemination of information to administrators and other school personnel.

Perhaps the pivot point of the entire implementation process is that of citizen and government approval of the very idea of the educational technology system. It is especially necessary that the system have grassroots support at the state level, and it is for this reason that local school officials and other officials, both in education and within the overall political structure, should be informed of and allowed to partake in the processes which will lead to the making of decisions concerning organization, funding, dissemination, and timetables. Of chief concern is the tearing down of the myth that technology brings with it regimentation and a loss of individualization. One of the easiest ways to alleviate many of the fears of administrators, teachers, and other citizens is actually to demonstrate the technology that will be used, and this kind of demonstration might also play a major role in informing the public. It should then follow that once citizen support is obtained, political leaders within the state will feel compelled to approve the educational technology system. If citizen support is not strong, however, it may be necessary to encourage the adoption of such a system through the use of lobbies, etc. Along the same lines, requests for funding should be made of both private and federal organizations and agencies.

Besides breaking down barriers to acceptability by opening lines of communication and initiating lobbying for funds at state and federal levels, it is necessary to lobby against other barriers to the implementation of educational technology. As previously discussed in the chapter on software, a principal barrier which presently exists is that of copyright legislation. Other legal constraints may arise, and it may indeed be wise to establish permanent ties with the federal government and with private organizations (such as software and hardware producers) to keep tabs on present and impending changes in legislation and within the fields of educational technology and communications in general.

These conclusions concerning a proposed solution strategy are decidedly general in nature; however, it should be the responsibility of the policy-making board to lay down specific solution strategies and guidelines for the implementation of the educational technology system. Only a group with substantial and current knowledge of the present structure, the financial condition, and the political contingencies of the Texas educational system can supply such details to the overall plan.

Strategy summary. Specific conclusions in this area are:

(1) That clear-cut goals and objectives should be established for the state of Texas and should be disseminated and published to personnel on all administrative levels throughout the state.

(2) That a specific system of educational technology should be approved which will accomplish many or all of the goals and objectives of the state, and planning should be initiated for actual implementation of the technology. It should encompass the financial, personnel, organizational, scheduling, maintenance, and technological requirements.

(3) That efforts should be made to design the organization of the proposed technology so that it remains compatible with the existing educational structure in Texas and causes little disruption of the present organization.

(4) That efforts to obtain funding should be made early in the process, including contacting of federal and private agencies and lobbying at the state level. As part of this endeavor, specific attempts should be made to educate the public and legislature of the state concerning the proposed system.

(5) That attempts should be made to remove legislative barriers (such as copyright) and to obtain assistance from producers of educational software through lobbying and public relations efforts.

(6) That there be participation in the planning by members of all levels of education, to include needs and to provide feedback. Such action not only will enhance the quality of the planning, but will accomplish much to facilitate change.

OVERALL

In reviewing the conclusions just stated, we feel that they have the following desirable characteristics:

(1) They look toward and anticipate future situations;
(2) They embody long-term considerations;
(3) They are interactive and compatible with one another;
(4) They are minimally disruptive to present technology and organization;
(5) They are not too costly;
(6) They provide adequate flexibility;
(7) They provide for user needs and preferences;
(8) They facilitate individualization of instruction where appropriate.

To expand upon the above statements, any improvement in education is going to entail some increase in cost, either in additional teachers' salaries or in the purchase or lease of more technology that can carry out some of the teachers' duties. We feel that our conclusions here provide the greatest increment in technology for the least additional cost that can reasonably be expected. We further feel that these conclusions are in full support of the proposed Instructional Resources System, not only with regard to the technology itself, but with regard to the structure and content of all five of the programs. The directions proposed here will permit the gradual installation and implementation of a comprehensive statewide system of educational technology. As utilization of this system effects increasing improvements in education, growing acceptance and enthusiasm will in turn increase the speed with which the system approaches its maximum potential.

A further conclusion is that the time to act is now. Education still lags far behind technology, and inaction now will have devastating consequences in the long run.

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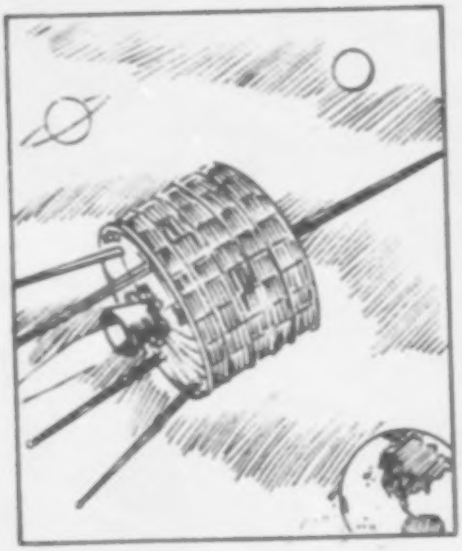
National Academy of Engineering, Commission on Education, Advisory Committee on Issues in Educational Technology. Issues and Public Policies in Educational Technology. Lexington, Massachusetts: Lexington Books, D. C. Heath and Company, 1974. 84 pp.

Turoff, Murray. "Delphi and Its Potential Impact on Information Systems." Paper presented at the Fall Joint Computer Conference, Las Vegas, Nevada, 1971. Montvale, New Jersey: AFIPS Press (American Federation of Information Processing Societies, Inc.), 1971.

recommendations

XI



PRÉCIS

The recommendations of this study follow the findings and conclusions fairly straightforwardly. The general opening section discusses three significant aspects of future actions: timeliness of succeeding actions, emphasis on change, and participation in planning and implementation by persons at all levels; and makes recommendations in each area.

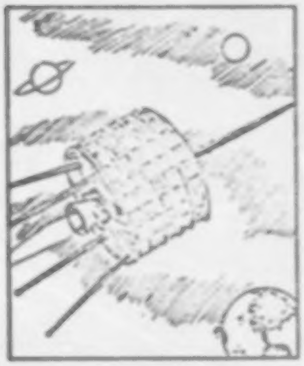
The next section contains 15 specific recommendations. Included are recommendations for: emphasis on audiovisual methods, using an expanded CATV network extending to nearly all campuses as the principal system of delivery; expanding the use of CAI/CMI methods, using the same CATV network for narrowband channels; establishing a vigorous public relations, orientation, planning, and participation effort, thus leading toward successful change endeavors; using leased (rather than owned) arrangements wherever possible; establishing a State Council for Educational Technology under the State Board of Education; and planning funding, training, dissemination, and coordination efforts as appropriate. Other recommendations support these main points.

The closing section presents a list of documents which should be required reading for those persons involved in any succeeding activities.

The sections of this chapter are:

General p. XI-1
Specific p. XI-1
Major References p. XI-5

Not actually part of this chapter, but a part of the whole report, is the Epilogue, which was prepared after all the rest of the report had been written and which appears at the end of this chapter on page XI-7.



XI

RECOMMENDATIONS

GENERAL

Timeliness

Throughout this study, we encountered many authors and reports lamenting the lack of progress in the usage of educational technology. It is generally recognized that the basic reasons for non-adoption involve high cost, uncertainty of success, or overall lack of awareness. Embedded in these several factors is a general resistance to change, and occasionally this is the sole reason for non-adoption.

Educational innovation is a sluggish process, remaining, at best, well behind change techniques already proven in the military and in industry. We have taken pains here to feature those change methodologies that are feasible given the current state of the art, that have been satisfactorily proven, that are within financial reach, and that are increasing in usage rather than obsolescing.

Accordingly, we recommend that approval of the recommendations which follow be given rapidly and that planning be started, so that the least possible time is lost.

Change

We have given heavy emphasis in this study to the process of change. It may be that some of our specific findings, conclusions, or recommendations do not actually mention change; however, the need to plan for the change process is implied throughout, and we strongly recommend that substantial emphasis be given to the various aspects of such planning in all subsequent actions at all levels.

Participation

The essence of our findings is that no overall, statewide network or system is either necessary or desirable, and that much of the development of network systems and planning and operation of technology should be done at the regional, district, and local levels. To accomplish this readily and successfully, however, requires considerable expertise in coordination and orientation. We therefore recommend that maximum participation be encouraged and obtained at all levels, both to meet specific needs and to effect change agentry.

SPECIFIC

Based on all the foregoing, the following recommendations are made:

(1) It is recommended that the overall system of educational technology in Texas be based on providing cable channels to nearly every school campus. Cable delivery systems can be interconnected, and can provide great flexibility in receiving broadcast programs, conducting closed circuit programs at regional, district, or campus levels, or using recording devices for presenting instruction under the same conditions or to only one or two students. (See Figure XI-A, "Commercial TV in Texas," and Figure XI-B, "Texas Population Density by Counties," to follow, which appeared previously in this study on pages V-20 and VI-32, respectively.)

COMMERCIAL CATV IN TEXAS

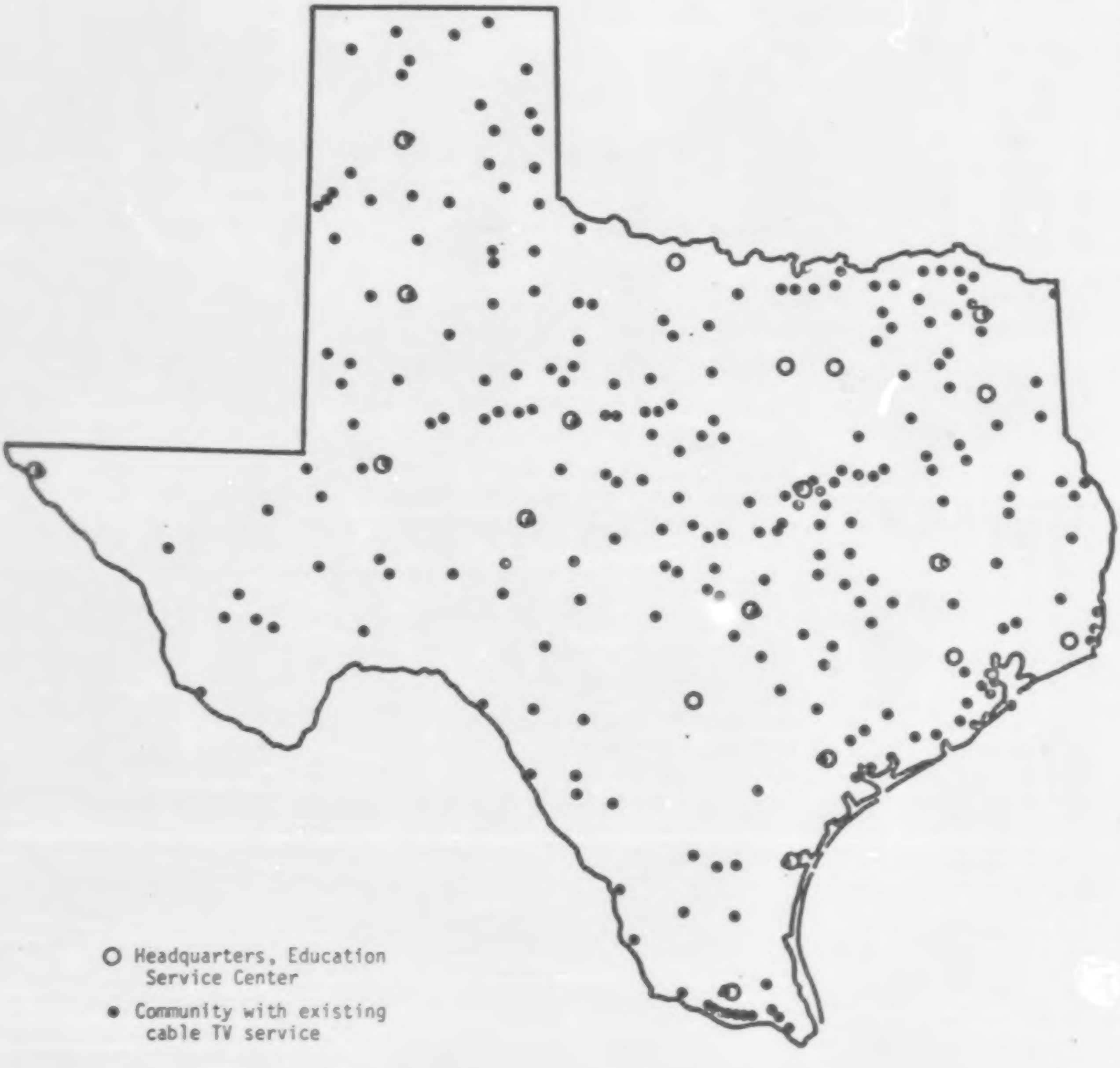

○ Headquarters, Education Service Center
● Community with existing cable TV service

Figure XI-A

POPULATION DENSITY BY COUNTIES

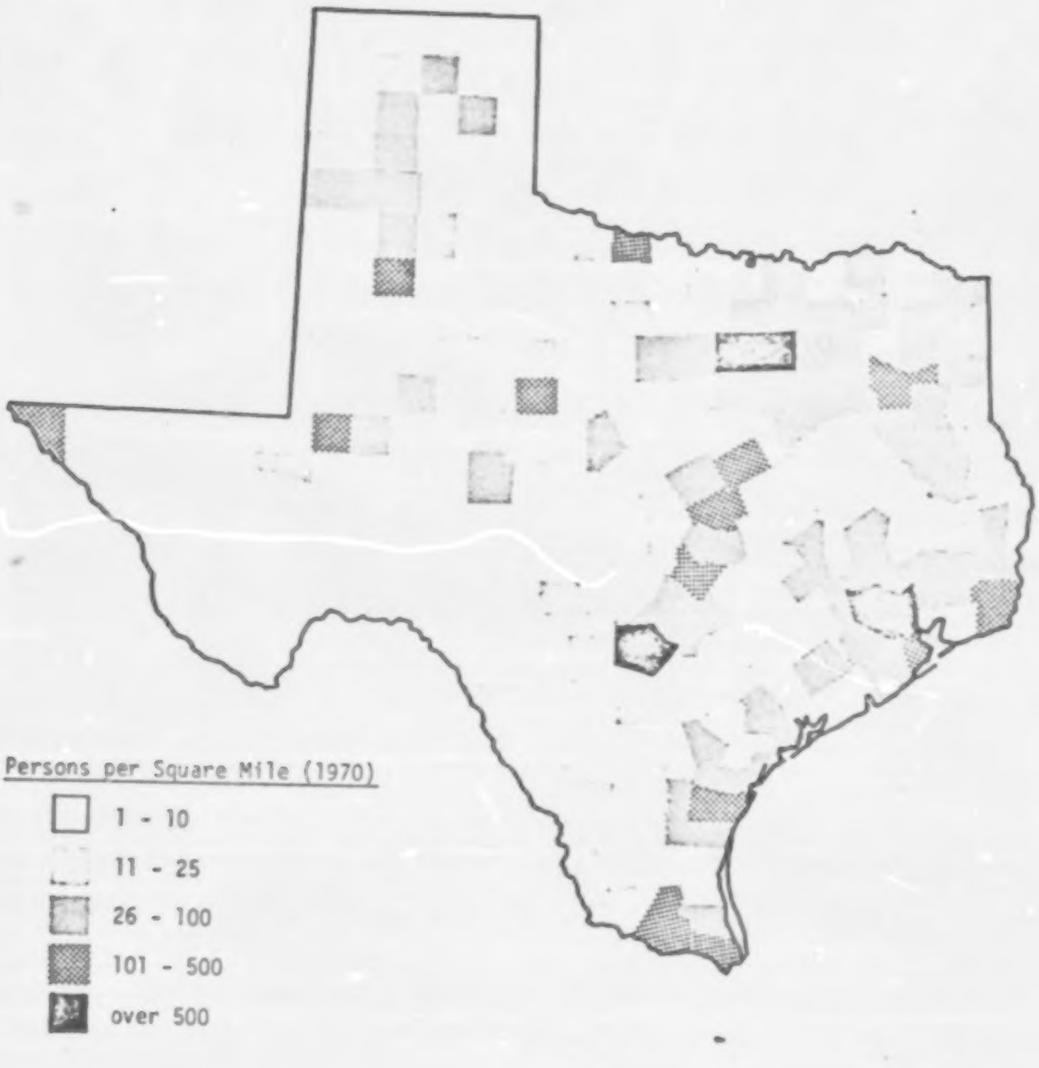

Persons per Square Mile (1970)
☐ 1 - 10
▨ 11 - 25
▨ 26 - 100
▨ 101 - 500
■ over 500

Figure XI-8

(2) It is also recommended that other channels in the same network be multiplexed and that narrowband channels be rented to provide computer-managed instruction (CAI/CMI). These channels can also handle administrative and management information handling, reporting, and dissemination, both for TEA management information systems and for the Instructional Resources management system.

(3) Much greater emphasis should be placed on the expansion and use of CAI/CMI systems. Presently, such systems constitute a tag-along to MIS planning; by now, the reverse should be starting to occur, for CAI/CMI is gaining so much success and momentum nationwide that it should no longer be treated as a poor relation.

(4) The enlargement of cable television(CATV) networks, the acquisition of multiplexed circuitry, and the use of major equipment (e.g., large computers) should all be on a leased basis, although small, peripheral items of equipment should be bought rather than leased. Careful consideration should be given to the use of a prime contractor for the planning and implementation phases. (This is neither specifically recommended nor cautioned against; however, due cognizance has been taken of the success of the prime contractor systems used by the military, by governments of small countries, and by various other institutions for other complex endeavors.)

(5) To avoid a peak of expense and to level out the costs over an extended period of time, it is recommended that incremental implementation take place, phased evenly over several years. One of the larger initial expenses might be the subsidization of cable companies, who could not afford to extend their systems to all campuses on a purely profit basis. Another big cost might be the initial procurement of many computer terminals and audiovisual terminal devices, and a third major cost might be the procurement of initial software packages. Thereafter, rental and replacement costs should level off.

(6) Vigorous action should be initiated by TEA during the next session of the Texas Legislature to amend existing legislation to include audiovisual software and computer courseware in the same category with textbooks in the adoption program.

(7) Within the existing educational structure, but not under TEA, a State Educational Technology Council should be set up, responsible to the State Board of Education. This Council should then initiate and maintain contacts with higher education, with commercial endeavors, with other state educational organizations, and with learning resource centers at district and regional levels, and should provide general guidance and supervision to the operation of educational technology throughout the state.

(8) The Texas Educational Goals and Objectives should be re-examined and revised to reflect an appropriate emphasis on educational technology and the accompanying methodology, and the revised statements should be disseminated.

(9) The State Board of Education should make clear its position on the findings of this report, and, if it concurs, should encourage all other educational agencies within the state to begin implementation planning.

(10) Some parts of the planning should be centralized through the Texas Education Agency, others should be delegated (to regional, district, and campus levels); in general, the central planning should be done first so that other plans can be integrated and meshed appropriately. Thus, central planning should begin posthaste.

(11) TEA should assist with delegated planning activities by means of guidelines, models, technical assistance, and funds.

(12) TEA should conduct a conference (or series of conferences) for operators of cable systems, representatives of telephone companies, hardware vendors, software vendors,

and various federal and state officials; such a conference might last several days. The objective would be to announce general findings and intentions, identify implementation needs, pitfalls, and hazards, and hammer out some means and methods for accomplishment.

(13) TEA should mount a strong public relations and orientation effort regarding its intentions, aimed at overcoming lethargy in the legislature, at regional and local levels, on the part of parents, teachers, associations, and unions, and most of all on the part of TEA officials themselves, since any lack of initiative at this level could cause a standstill.

(14) TEA should take a strong position with regard to technology dissemination, and become a national leader in this area. Setting this sort of pattern could not only attract local following and the federal spotlight, but gain federal funds to assist as well.

(15) Much in-service training will be needed for teachers, administrators, and support personnel, not only to teach them about specific systems, equipment, methods, and curricula in their own locales, but also to bring them up to date in the whole field of educational technology.

(16) Suitable input should be made to colleges and universities that teach teachers, so that certified teachers will know more about educational technologies, and the various uses made of them in Texas, and will be better prepared to use them in their own schools. Similarly, these institutions should have greater impact upon teachers' ability to keep current with regard to technological progress.

MAJOR REFERENCES

During the course of our study, we encountered a number of documents of especially significant content. We have pared this last to an almost absurd brevity; however, we believe that these few books are essential to a comprehensive understanding of current developments in educational technology. Therefore, we offer the list as being a more useful tool than a complete bibliographical listing of all the sources we used.

Baer, Walter S. Cable Television: *A Summary Overview for Local Decisionmaking*. Santa Monica, California: The RAND Corporation, 1973.

Baran, Paul. "Broad-Band Interactive Communication Services to the Home: Part I--Potential Market Demand." *IEEE Transactions on Communications* (January 1975), 5-15.

________. "Broad-Band Interactive Communication Services to the Home: Part II--Impasse." *IEEE Transactions on Communications* (January 1975), 178-184.

Brown, James W. (ed.). *Educational Media Yearbook 1974*. New York: R. R. Bowker Company, 1974.

Hope Reports, Inc. *Hope Reports* (Vol. 1: *AV-USA*; Vol. 2: *Education and Media*; Vol. 3 varies from year to year). Rochester, New York: Hope Reports, Inc., published annually.

Husen, Torsten. *The Learning Society*. London: Methuen and Company, 1974. 286 pp.

Levien, Roger E., *et al*. *The Emerging Technology: Instructional Uses of the Computer in Higher Education*. A Carnegie Commission on Higher Education and RAND Corporation Study. New York: McGraw-Hill Book Company, 1972. 585 pp.

Martin, James. *Telecommunications and the Computer*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1969. 470 pp.

National Academy of Engineering, Commission on Education, Advisory Committee on Issues in Educational Technology. Issues and Public Policies in Educational Technology. Lexington, Massachusetts: Lexington Books, D. C. Heath and Company, 1974. 84 pp.

Tickton, Sidney G. (ed.). To Improve Learning: An Evaluation of Instructional Technology, Vol. 1. New York: R. R. Bowker Company, 1970.

________. To Improve Learning: An Evaluation of Instructional Technology, Vol. 2. New York: R. R. Bowker Company, 1971.

Toffler, Alvin (ed.). Learning for Tomorrow: The Role of the Future in Education. New York: Random House, 1974. 421 pp.

EPILOGUE

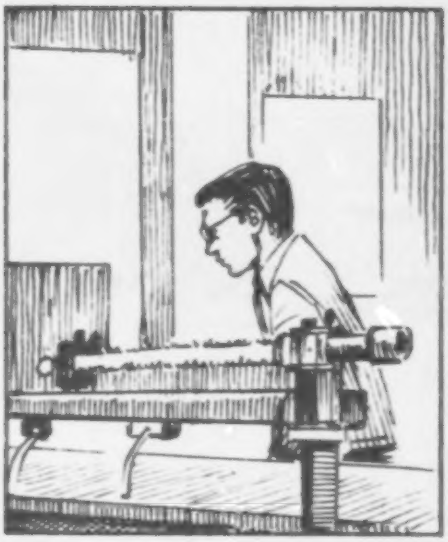
Since completion of the Texas Educational Telecommunications Study, a newly published book has come to our attention. It comprises an in-depth, nationwide study of the same topic, performed by members of the staff of the Battelle Communications Research Laboratory for the U. S. Office of Education.* The study focuses on educational broadcasting and extrapolates present trends into the future. It constitutes a comprehensive review of the state of the art of telecommunications with regard to education.

The findings and conclusions of the Battelle study are strikingly similar to those we have presented here. Unfortunately (or, possibly, fortunately) we were not aware of this study while performing our own, nor was Battelle aware of ours. We are pleased to note, however, that a more eminent and better-known organization has made essentially the same findings. And we are also pleased to see that our study examines a number of factors, methodologies, and concepts that are omitted from the Battelle study. Nevertheless, we commend the latter to your reading.

---

*Tressel, George W., Donald P. Buckelew, John T. Suchy, and Patricia L. Brown. The Future of Educational Telecommunication. A Planning Study. Lexington, Massachusetts: Lexington Books, D. C. Heath and Company, 1975. 126 pp.

appendices



PRÉCIS

Five appendices comprise the following pages, as follows:

Alfa--copies of the letters, questionnaire, and forms sent out in the course of the Needs Survey, as described in Chapter IV. This appendix constitutes 19 pages.

Bravo--the statistical tabulations of the responses from the Needs Survey. These, too, are discussed in Chapter IV. Appendix Bravo consists of 21 pages.

Charlie--a listing of participants in the various Texas library communication networks. It supports some of the material presented in Chapter V and comprises four pages.

Delta--a table showing the computer processing facilities (including CAI) of the 20 Regional Education Service Centers in Texas. It relates to material in Chapter V, and is on one page.

Echo--descriptions of all the technologies discussed and assessed in Chapter IX. This material is presented on four pages.

APPENDIX ALFA

This appendix comprises several pages related to the statewide survey of educational needs, as described in Chapter IV. Appendix Alfa includes the letters and forms mailed out; Appendix Bravo presents the statistical results.

On the following pages are:

1. Letter of advance notice (1 side) (sent to all addressees three weeks early)
2. Letter of transmittal (2 sides)
3. Biographical data and essay replies (2 sides)
4. Teacher questionnaire (3 sides)
5. Administrator questionnaire (3 sides)
6. Standard answer form (1 side)
7. Follow-up postcard (1 side) (sent to nonrespondents after three weeks)

EDUCATIONAL DEVELOPMENT CORPORATION
2813 RIO GRANDE
AUSTIN, TEXAS 78705

(512) 476-6868
476-5419

20 January 1975

This letter is both an alert and a request--an alert that a questionnaire will be headed your way soon, and a request that you will give it the serious attention it deserves.

We have contracted with the Texas Education Agency to conduct a study of educational technology requirements in Texas, and of the telecommunications needed to support them. We visualize technology as the methods used to attain goals and objectives, and to enhance the teaching/learning process in so doing. This study is an adjunct to the development of the comprehensive Instructional Resources System for Texas, which should be partially operational by 1976.

The persons actually involved in education are best equipped to say what is needed in education; and there must be full comprehension of what problems exist, and why, before any thought can be given to designing solutions. So our questionnaire attempts to find out what problems must be solved, not how to solve them, although we are looking for ideas about solutions for the problems you have. Some questions should elicit your impressions of particular solutions, or technologies, and what new problems you feel that their implementation might bring.

We've tried to make the questionnaire as painless as possible; almost no narrative is requested. It will probably take about 45 minutes to one hour of your time. As we are a small outfit, we can collect only a small sample of opinion--and every response counts a lot. Please start thinking about the subject now; then, when the questionnaire arrives soon, you will be prepared and ready to help us.

Sorry we can't offer sweepstakes awards, but we actually have a better deal--you will know that you've contributed significantly to the improvement of the teaching/learning system for the children of Texas. Thank you for your attention, deliberation, and input, both now and later.

Sincerely,

George M. Higginson
Director, NEEDS Division

EDUCATIONAL DEVELOPMENT CORPORATION
2813 RIO GRANDE
AUSTIN, TEXAS 78705

(512) 476-6868
476-5419

31 January 1975

As you know from our earlier letter, we're doing the Texas Educational Telecommunications Study. Descriptions of our objectives and procedures are on the back of this letter.

We know that you're bothered with too many pieces of junk mail, advertisements, questionnaires, and neat offers; however, we implore you to understand the scope and importance of this survey, and to take the time to make your input to the decision-making process which will follow. We're not big enough to ask every educator in Texas, so every response we get from our sampling will weigh heavily. Your response will become part of the total of needs and problems we are trying to identify.

This packet contains the following:
- (a) This sheet, which need not be returned;
- (b) The questionnaire package, stapled together, which also should not be returned (pages 1-3);
- (c) The answer package, which should be returned. It comprises a Standard Answer Sheet A, a longhand answer sheet (page 4), and a Biographical Data sheet on the reverse (page 5);
- (d) A postage-paid, addressed envelope.

There are several questions, and we solicit your patience in responding to them. Every question has a purpose; every point is geared to some decision. Put your opinions on the Standard Answer Sheet, and add any comments on the separate sheet provided for written information. Omit personal data from the Standard Answer sheet.

Upon completion, please mail the answer sheet with the biographical data and your written comments in the postage-paid envelope enclosed. We'll be most grateful for your assistance. Please tackle this task as soon as you have given it enough thought, but in any case, not later than 15 February 1975.

Thank you very much.

Sincerely,

George M. Higginson

George M. Higginson
Director, NEEDS Division

Encl.

EXPLANATION OF OUR TELECOMMUNICATIONS STUDY AND THIS NEEDS SURVEY

Educational resources, long limited primarily to teachers, and to textbooks and other print media, are now viewed as encompassing a wide range of increasingly sophisticated technology. Technology, in this context and in the words of the Presidential Commission on Instructional Technology, "....means the media born of the communications revolution which can be used for instructional purposes alongside the teacher, textbook, and blackboard." These media are becoming steadily more desirable for classroom use, but, at the same time, they are becoming more difficult to implement, both because of their greater sophistication and because of their tremendously broadened scope. Networks of connecting communications media might alleviate some part of this difficulty, but such systems cannot begin to be set up without extensive study of existing and projected educational requirements and intensive planning to meet these requirements.

Since 1971, the Texas Education Agency has been involved in the Texas Study of Public School Instructional Resources, resulting in the conceptualization of a statewide Instructional Resources System. In this system, the term "instructional resources" is taken to encompass all instructional components, including both printed and audiovisual media, as well as other formats of materials, their accompanying equipment, systems for their use in instruction, and personnel and skills required. The ultimate function of the system will be to make appropriate materials and equipment available to all the public schools in the state.

If a statewide Instructional Resources System is to be implemented successfully, it will require a number of support activities, and one of these may be a network of statewide telecommunications. To determine the requirements for such a network the NEEDS Division of the Educational Development Corporation is performing a context analysis, or needs assessment, study of Texas educational telecommunications under a nine-month contract with the Texas Education Agency. During this time, EDCo proposes to (1) identify communications needs, statewide; (2) identify potential users for the various technologies to satisfy their needs; (3) see what is already available; (4) study the probable success or failure of methods of supplying solutions for the remaining needs; and (5) make findings and recommendations based on the outcomes of the study.

The attached questionnaire represents an attempt to determine needs as perceived by teachers, administrators, and other educational personnel throughout the state. As we see it, needs are identified in efforts to solve problems; problems may exist in trying to meet objectives. Our premises regarding needs are tied to TEA's educational goals, your school's objectives, and the resources required to meet them. The survey should also assist us somewhat in discovering what technology is currently available and in use. As this comprises a vital part of the overall study, we hope that you will take time to give the questionnaire some critical thought, and that you will answer it with an awareness of the importance of your role in shaping future developments in educational technology and telecommunications in Texas.

BIOGRAPHICAL DATA SHEET

Name (optional) ____________________

Address (optional) ____________________

Title of your present position ____________________

Age: (check one) ________ under 25 ________ 26-35 ________ 36-50 ________ over 50

Sex ____________ Highest degree earned ____________ Grade taught (if any) ____________

Specialty or subject ____________________ Total years in education ____________

Within the coverage of which Regional Education Service Center is your school district located? ________

What is the size of your school district in terms of ADA (average daily attendance)? (check one)

________ over 50,000 ________ 10,000-49,999 ________ 5,000-9,999 ________ 1,500-4,999 ________ under 1,500

How many different types of educational technology do you use in your position? ____________

Do you think you are keeping up sufficiently with information about instructional and educational technology? (check one) ________ yes ________ no

Do you mind if things change, as long as they change for the better? ________ yes ________ no

Do you consider yourself innovative? (check one) ________ yes ________ no

In your full scope of responsibility, how many pupils are served? ____________

How many teachers report to you? (How many do you supervise?) ____________

How many ethnic/cultural categories are there in your area of responsibility (including Anglo)? ________

Approximate percentage of pupils in these socio-economic categories: (answer each item)

______ % rich ______ % upper-middle class ______ % middle class ______ % lower middle ______ % poor

Characteristics of community in which you work: (circle one item from each line)

rural small town small city suburban urban

industrial agricultural commercial inner-city college or university

Does your school or district have centralized Library/Learning Resource Centers (LLRCs)? _____ yes _____ no

Are the Library/Learning Resource Centers staffed with certified professionals? ________ yes ________ no

How frequently do you interact with the Library/Learning Resource Center? (check one)

________ several times a day ________ daily ________ weekly ________ rarely ________ never

Which kind of interaction predominates in the Library/Learning Resource Center? (check one)

________ requests ________ information volunteered by Center staff ________ issues and returns

________ instruction (scheduled or unscheduled) ________ informational discussions

Do you use educational TV broadcasts? ________ yes ________ no If so, how often? ______ times per week.

How many educational channels do you have from which to select? ____________

Do you have color TV sets available when needed? ________ yes ________ no

Do you have black and white TV sets available when needed? ________ yes ________ no

Where are TV sets available? (check one) ________ classrooms ________ library ________ other

Is your campus connected to a cable TV system? ________ yes ________ no ________ don't know

Is the campus wired: for closed circuit TV? ________ yes ________ no ________ don't know

for any other electrical/electronic system? ________ yes* ________ no ________ don't know

*If "yes," specify type(s): ____________________

____

On this page, please write in any additional responses you made to the items identified below. BE SURE TO FILL OUT THE BIOGRAPHICAL DATA FORM ON THE BACK OF THIS SHEET AND RETURN THE STANDARD ANSWER FORM AND THIS SHEET TO: Educational Development Corp., 2813 Rio Grande, Austin, TX 78705.

Part A. ____________________

Part B. ____________________

Part C. ____________________

Part D. ____________________

Part H. ____________________

108. Why?:

Additionally, please answer the following two questions:

What changes would you recommend in teacher preparation programs to improve the skills of beginning teachers in the employment of educational technology to improve pupil learning? (Please describe in your own words, using additional sheets if necessary.)

Please list and comment on any other effects on you which you perceive that the availability and use of telecommunications technologies would have, pro or con. (Use your own words and take as much space as necessary, using extra sheets.)

Teacher

INSTRUCTIONS

For items 1 through 73, you are asked to mark on your answer sheet one response for each item using the five categories of responses listed below:

A	B	C	D	E
Urgent Need	Moderate Need	Adequate as is	Not needed; may be undesirable	Definitely not needed; highly undesirable

For example, if you feel that #1, Changing role of the school, is an area in which there is an urgent need for more teacher information and training, darken space "A" beside #1 on your answer sheet. For example:

	A	B	C	D	E
1.	■	☐	☐	☐	☐

If, on the other hand, you feel that training and information in the changing role of the school may be undesirable, mark "D" on your answer sheet beside #1. For example:

	A	B	C	D	E
1.	☐	☐	☐	■	☐

Continue marking each item through #73 according to the responses listed above. PLEASE BE SURE TO USE A NO. 2 PENCIL. ERASE COMPLETELY IF YOU CHANGE AN ANSWER.

PART A

To what extent is additional instruction (or lesser amounts of information) needed on the following topics so that teachers may improve instruction in the schools?

1. Changing role of the school
2. Structure of knowledge
3. Sources of content knowledge
4. Information reduction/retrieval
5. Cognitive development
6. Learning styles
7. Open schools
8. Team teaching
9. Developing learning modules
10. Planning and organizing for instruction
11. Educational applications of recorded media
12. Computers in school
13. Self-instructional systems
14. Affective teaching
15. Applied behavior modification

Other (please write in beside Part A on page 4)

PART B

To what extent do you feel that teachers desire assistance in improving the overall performance of the following tasks?

16. Diagnosing individual pupil learning difficulties
17. Prescribing individual instruction
18. Defining educational objectives
19. Presenting information interestingly
20. Motivating pupils to think for themselves
21. Relating instruction to everyday life situations
22. Communicating with pupils of different ethnic/racial backgrounds
23. Communicating with pupils of different socio/economic backgrounds
24. Devising testing/measuring instruments
25. Involving students in self-evaluation
26. Assigning grades
27. Directing student investigations
28. Questioning strategies
29. Stating objectives in measurable terms
30. Communicating with pupils in nonstructured situations
31. Selecting/developing materials

Other (specify beside Part B on page 4)

PART C

To what extent do teachers need assistance in teaching the following skills/processes more effectively?

32. Spoken English
33. Written sentence construction
34. Vocabulary development
35. Accurate spelling
36. Expository writing
37. Persuasive writing
38. Creative writing
39. Speaking a foreign language
40. Writing a foreign language
41. Reading for meaning
42. Reading in content subjects
43. Stating problems in abstract terms
44. Abstract reasoning
45. Arithmetic concepts
46. Analysis of a problem or question
47. Formulating hypotheses
48. Finding sources of information
49. Finding relevant information
50. Note taking/information recording skills
51. Organizing information
52. Synthesizing information
53. Enhancing creative approaches
54. Building performance skills

Other (specify beside Part C on page 4)

PART D

In which of the following content areas of instruction do you feel that the use of media and technology would be most useful in helping to improve the quality of pupil learning?

55. Language arts
56. Mathematics
57. Science
58. Social studies
59. Foreign language
60. Fine arts
61. Vocational education
62. Career education
63. Physical education
64. Special education

Other (identify beside Part D on page 4)

PART E

Assuming that adequate equipment and programming were available, how necessary and desirable are each of the following telecommunications technologies as an aid to improving instruction in your school?

65. Audio cassettes or tapes
66. Broadcast, cable, or closed circuit TV
67. Video tape or recordings
68. Motion picture films
69. Long distance sending and receiving of printed and pictorial information
70. Dial access systems allowing pupil to call up lessons or information he needs on tape, film, TV
71. TV systems that allow pupil responses to be recorded
72. Computer systems for individual instruction and testing of pupils
73. Audio systems which allow pupils to listen, record responses, check responses, and replay items

INSTRUCTIONS FOR ITEMS 74-92

Mark on your answer sheet for items 74-92 your opinions according to the following categories of responses:

A	B	C	D	E
Strongly support	Probably support	Unknown	Probably do not support	Vigorously oppose

PART F

Given a situation in which adequate tapes, films, programs and accompanying equipment are available, what is the attitude that you think your school board would have toward using the technologies below in your school system if they were not provided through state funding and had to be paid for by local taxes and funding?

74. Audio cassettes or tapes
75. Broadcast, cable, or closed circuit TV
76. Video tape or recordings
77. Motion picture films
78. Long distance sending and receiving of printed and pictorial information
79. Dial access systems allowing pupil to call up lessons or information he needs on tape, film, TV
80. TV systems that allow pupil responses to be recorded
81. Computer systems for individual instruction and testing of pupils
82. Audio systems which allow pupils to listen, record responses, check responses, and replay items

PART G

Given a situation in which adequate tapes, films, programs and accompanying equipment are available, what is the attitude that you think that most parents in your district would have toward the use of the technologies below in your school system if they were not provided through state funding and had to be financed locally?

83. Audio cassettes or tapes
84. Broadcast, cable, or closed circuit TV
85. Video tape or recordings
86. Motion picture films
87. Long distance sending and receiving of printed and pictorial information
88. Dial access systems allowing pupil to call up lessons or information he needs on tape, film, TV
89. TV systems that allow pupil responses to be recorded
90. Computer systems for individual instruction and testing of pupils
91. Audio systems which allow pupils to listen, record responses, check responses, and replay items

92. If state funding were provided for any of the technologies listed above, to what extent do you think that parents would support the use of that technology (no matter which one) in the instructional program of your school? (give only one answer)

INSTRUCTIONS FOR 93-107

In questions 93-107, the collective term "educational technology" is used to mean the content, equipment, programs, and procedures for their use provided by a variety of learning/communication systems such as videotape, television, audio cassettes or tapes, pupil response systems, and computer aided instructional systems.

For items 93-107, please mark your answer sheet according to whether you:

A	B	C	D	E
Strongly agree	Agree	Have no opinion	Disagree	Strongly disagree

93. The use of educational technology in schools frees the teacher from lecturing and consequently allows more time to be spent with individual pupils.
94. Using educational technology takes more teacher time than traditional teaching methods.
95. Using educational technology improves teaching effectiveness for the time invested.
96. Using educational technology requires that teachers invest more time in scheduling and preparation.
97. Using educational technology requires that teachers spend more time following up on what pupils have learned.
98. Using educational technology creates disciplinary problems in a class.
99. Using educational technology requires more teaching skills that other approaches.
100. When using educational technology, the teacher loses control of scheduling of pupil activities.
101. When using educational technology, the teacher loses control of what is taught.
102. Using educational technology necessitates too much coordination on the part of the teacher to be worth the effort.
103. In order to select appropriate methods to help individual pupils learn best from the varieties of educational technology available, teachers need the help of a learning resources selection and utilization specialist.
104. The introduction of educational technology into a school also requires the addition of an equipment maintenance specialist to the school staff.
105. The introduction of educational technology into a school also requires the assistance of a testing and measurement specialist.
106. Teachers cannot be expected to write, develop, and produce programs and content to be used in systems employing educational technology.
107. The extensive use of educational technology in a school requires the availability of design and production staff to help teachers prepare materials.

---

108. Given the availability of equipment, materials, and instructions for pupils to obtain learning programs two days a week for independent study at home through their TV sets (or equally simple and available equipment), would you judge the development to be: (mark one response)

A	B	C	D	E
Highly desirable	Desirable	Undecided	Undesirable	Highly Undesirable

Why? (Please explain in your own words beside #108 on page 4.)

109. Do you think teachers would prefer these courses as individualized, programmed, do-it-yourself materials (which they would do on their own time, but upon which they would be tested), or as a group training session, as is now usually the case? (mark one response)

A	B	C	D	E
Strong preference for individualization	Lean toward individual training	Equal amounts of both	Prefer the interaction	Definitely group training

110. Given that the subject of educational accountability will gain momentum and become more stringent, while at the same time (but unrelatedly) instructional technologies become improved and more widespread, how do you see the relationship of the two? (mark one response)

A	B	C	D	E
Technology guarantees security	Technology could improve teaching	Undecided	Technology may cause loss of classroom control	Uncontrolled technology makes everyone vulnerable

111. What is your assessment of the skills related to the use of educational technology that most beginning teachers possess upon completion of their pre-service programs? (mark one response)

A	B	C	D	E
Very skilled	Skilled	Undecided or Unknown	Only slightly skilled	Very unskilled

INSTRUCTIONS FOR ITEMS 112-127

Mark each item from 112-127 on your answer sheet according to the following responses:

A	B	C	D	E
Very willing	Willing	Undecided	Unwilling	Very unwilling

Mark only one response for each item.

PART H

Indicate on your answer sheet your willingness to use the technologies listed below to improve your skills through in-service activities during released time from instruction during the school day.

112. Broadcast of cable TV
113. Computer based instruction
114. Motion picture film
115. Videorecordings
116. Audio tapes or cassettes
117. Automated information searches providing bibliographical citations
118. Automated information searches with facsimile transmission of information
119. Dial access systems with videodisplay

Other (please specify beside Part H on page 4)

Indicate on your answer sheet your willingness to use the technologies listed below to improve your skills through inservice activities held after school or accomplished on your own time outside the school day.

120. Broadcast or cable TV
121. Computer based instruction
122. Motion picture film
123. Videorecordings
124. Audio tapes or cassettes
125. Automated information searched providing bibliographical citations
126. Automated information searches with facsimile transmission of information
127. Dial access systems with videodisplay

Administrator

For items 1 through 73, you are asked to mark on your answer sheet one response for each item using the five categories of responses listed below:

A	B	C	D	E
Urgent Need	Moderate Need	Adequate as is	Not needed; may be undesirable	Definitely not needed; highly undesirable

For example, if you feel that #1, Changing role of the school, is an area in which there is an urgent need for more teacher information and training, darken space "A" beside #1 on your answer sheet. For example:

A B C D E
1. ■ ☐ ☐ ☐ ☐

If, on the other hand, you feel that training and information in the changing role of the school may be undesirable, mark "D" on your answer sheet beside #1. For example:

A B C D E
1. ☐ ☐ ☐ ■ ☐

Continue marking each item through #73 according to the responses listed above. PLEASE BE SURE TO USE A NO. 2 PENCIL. ERASE COMPLETELY IF YOU CHANGE AN ANSWER.

PART A

To what extent is additional instruction (or lesser amounts of information) needed on the following topics so that teachers may improve instruction in the schools?

1. Changing role of the school
2. Structure of knowledge
3. Sources of content knowledge
4. Information reduction/retrieval
5. Cognitive development
6. Learning styles
7. Open schools
8. Team teaching
9. Developing learning modules
10. Planning and organizing for instruction
11. Educational applications of recorded media
12. Computers in school
13. Self-instructional systems
14. Affective teaching
15. Applied behavior modification
    Other (please write in beside Part A on page 4)

PART B

To what extent do you feel that teachers desire assistance in improving the overall performance of the following tasks?

16. Diagnosing individual pupil learning difficulties
17. Prescribing individual instruction
18. Defining educational objectives
19. Presenting information interestingly
20. Motivating pupils to think for themselves
21. Relating instruction to everyday life situations
22. Communicating with pupils of different ethnic/racial backgrounds
23. Communicating with pupils of different socio/economic backgrounds
24. Devising testing/measuring instruments
25. Involving students in self-evaluation
26. Assigning grades
27. Directing student investigations
28. Questioning strategies
29. Stating objectives in measurable terms
30. Communicating with pupils in nonstructured situations
31. Selecting/developing materials
    Other (specify beside Part B on page 4)

PART C

To what extent do teachers need assistance in teaching the following skills/processes more effectively?

32. Spoken English
33. Written sentence construction
34. Vocabulary development
35. Accurate spelling
36. Expository writing
37. Persuasive writing
38. Creative writing
39. Speaking a foreign language
40. Writing a foreign language
41. Reading for meaning
42. Reading in content subjects
43. Stating problems in abstract terms
44. Abstract reasoning
45. Arithmetic concepts
46. Analysis of a problem or question
47. Formulating hypotheses
48. Finding sources of information
49. Finding relevant information
50. Note taking/information recording skills
51. Organizing information
52. Synthesizing information
53. Enhancing creative approaches
54. Building performance skills
    Other (specify beside Part C on page 4)

PART D

In which of the following content areas of instruction do you feel that the use of media and technology would be most useful in helping to improve the quality of pupil learning?

55. Language arts
56. Mathematics
57. Science
58. Social studies
59. Foreign language
60. Fine arts
61. Vocational education
62. Career education
63. Physical education
64. Special education
    Other (identify beside Part D on page 4)

PART E

Assuming that adequate equipment and programming were available, how necessary and desirable are each of the following telecommunications technologies as an aid to improving instruction in your school?

65. Audio cassettes or tapes
66. Broadcast, cable, or closed circuit TV
67. Video tape or recordings
68. Motion picture films
69. Long distance sending and receiving of printed and pictorial information
70. Dial access systems allowing pupil to call up lessons or information he needs on tape, film, TV
71. TV systems that allow pupil responses to be recorded
72. Computer systems for individual instruction and testing of pupils
73. Audio systems which allow pupils to listen, record responses, check responses, and replay items

INSTRUCTIONS FOR ITEMS 74-92

Mark on your answer sheet for items 74-92 your opinions according to the following categories of responses:

A	B	C	D	E
Strongly support	Probably support	Unknown	Probably do not support	Vigorously oppose

PART F

Given a situation in which adequate tapes, films, programs and accompanying equipment are available, what is the attitude that you think your school board would have toward using the technologies below in your school system if they were not provided through state funding and had to be paid for by local taxes and funding?

74. Audio cassettes or tapes
75. Broadcast, cable, or closed circuit TV
76. Video tape or recordings
77. Motion picture films
78. Long distance sending and receiving of printed and pictorial information
79. Dial access systems allowing pupil to call up lessons or information he needs on tape, film, TV
80. TV systems that allow pupil responses to be recorded
81. Computer systems for individual instruction and testing of pupils
82. Audio systems which allow pupils to listen, record responses, check responses, and replay items

PART G

Given a situation in which adequate tapes, films, programs and accompanying equipment are available, what is the attitude that you think that most parents in your district would have toward the use of the technologies below in your school system if they were not provided through state funding and had to be financed locally?

83. Audio cassettes or tapes
84. Broadcast, cable, or closed circuit TV
85. Video tape or recordings
86. Motion picture films
87. Long distance sending and receiving of printed and pictorial information
88. Dial access systems allowing pupil to call up lessons or information he needs on tape, film, TV
89. TV systems that allow pupil responses to be recorded
90. Computer systems for individual instruction and testing of pupils
91. Audio systems which allow pupils to listen, record responses, check responses, and replay items

92. If state funding were provided for any of the technologies listed above, to what extent do you think that parents would support the use of that technology (no matter which one) in the instructional program of your school? (give only one answer)

INSTRUCTIONS FOR 93-107

In questions 93-107, the collective term "educational technology" is used to mean the content, equipment, programs, and procedures for their use provided by a variety of learning/communication systems such as videotape, television, audio cassettes or tapes, pupil response systems, and computer aided instructional systems.

For items 93-107, please mark your answer sheet according to whether you:

A	B	C	D	E
Strongly agree	Agree	Have no opinion	Disagree	Strongly disagree

93. The use of educational technology in schools frees the teacher from lecturing and consequently allows more time to be spent with individual pupils.
94. Using educational technology takes more teacher time than traditional teaching methods.
95. Using educational technology improves teaching effectiveness for the time invested.
96. Using educational technology requires that teachers invest more time in scheduling and preparation.
97. Using educational technology requires that teachers spend more time following up on what pupils have learned.
98. Using educational technology creates disciplinary problems in a class.
99. Using educational technology requires more teaching skills that other approaches.
100. When using educational technology, the teacher loses control of scheduling of pupil activities.
101. When using educational technology, the teacher loses control of what is taught.
102. Using educational technology necessitates too much coordination on the part of the teacher to be worth the effort.
103. In order to select appropriate methods to help individual pupils learn best from the varieties of educational technology available, teachers need the help of a learning resources selection and utilization specialist.
104. The introduction of educational technology into a school also requires the addition of an equipment maintenance specialist to the school staff.
105. The introduction of educational technology into a school also requires the assistance of a testing and measurement specialist.
106. Teachers cannot be expected to write, develop, and produce programs and content to be used in systems employing educational technology.
107. The extensive use of educational technology in a school requires the availability of design and production staff to help teachers prepare materials.

---

108. Given the availability of equipment, materials, and instructions for pupils to obtain learning programs two days a week for independent study at home through their TV sets (or equally simple and available equipment), would you judge the development to be: (mark one response)

A	B	C	D	E
Highly desirable	Desirable	Undecided	Undesirable	Highly Undesirable

Why? (Please explain in your own words beside #108 on page 4.)

109. Do you think teachers would prefer these courses as individualized, programmed, do-it-yourself materials (which they would do on their own time, but upon which they would be tested), or as a group training session, as is now usually the case? (mark one response)

A	B	C	D	E
Strong preference for individualization	Lean toward individual training	Equal amounts of both	Prefer the interaction	Definitely group training

110. Given that the subject of educational accountability will gain momentum and become more stringent, while at the same time (but unrelatedly) instructional technologies become improved and more widespread, how do you see the relationship of the two? (mark one response)

A	B	C	D	E
Technology guarantees security	Technology could improve teaching	Undecided	Technology may cause loss of classroom control	Uncontrolled technology makes everyone vulnerable

111. What is your assessment of the skills related to the use of educational technology that most beginning teachers possess upon completion of their pre-service programs? (mark one response)

A	B	C	D	E
Very skilled	Skilled	Undecided or unknown	Only slightly skilled	Very unskilled

PART II

If the programming and software for telecommunications were provided for all schools in Texas by the state, indicate the portion of the cost for each item that you would be willing to bear from local funds in order to have the programming available to pupils in your school. (mark one response for each question)

A	B	C	D	E
None	0-25%	26-50%	51-75%	76-100%

112. Long distance transmission costs
113. Antenna systems to receive signals.
114. System to distribute signals throughout building
115. Television receivers (sets)
116. Rental/lease of computer terminals
117. Recording equipment to record real time transmissions for later use on video and audio players
118. Printed programmed instruction
119. Staff to assist pupils in use
120. maintenance personnel to repair equipment
121. Additional programming costs for software

Other (please specify under Part II on page 4)

INSTRUCTIONS FOR ITEMS 122-129

Please express your views about the needs or uses for each of the services described in 122-129, using these meanings for A through E:

A	B	C	D	E
Urgent need	Moderate need	Adequate as is	Not needed; may be undesirable	Definitely not needed; highly undesirable

PART I

122. A telecommunications system for querying a data base on cost estimates for various services and goods.
123. A dissemination program for administrators, alerting them to new policies and legislation affecting schools.
124. A current awareness service to alert administrators to significant journal articles and items in the literature.
125. A current awareness service to alert administrators to continuing education opportunities for themselves and for teachers.
126. Summaries and updates of new curricular developments.
127. Summaries and updates of new instructional materials.
128. Summaries and updates of developing technologies.
129. Research summaries of learning theories and concepts.

PROVIDE YOUR [illegible] IN [illegible] BOX [illegible] THEN BLACKEN THE LETTER BOX BELOW WHICH MATCHES EACH LETTER OF YOUR NAME.

YOUR LAST NAME

YOUR FIRST NAME

MI

TEACHER ONLY: STUDENT ABSENT FOR PART

STUDENT NUMBER

SEMESTER
FALL
SPRING

BIRTH DATE MO/YEAR

SEX

GRADE
1 2 3 4 5 6

FORM OF THIS TEST IS A B C D

1 2 3 4

SCHOOL

INSTRUCTOR

GRADE

TEST

A B C D E A B C D E A B C D E A B C D E A B C D E A B C D E A B C D E A B C D E

STANDARD ANSWER SHEET - A

PRINTED IN U.S.A.

DS-1120-A

15 Feb 1975

If you've already completed the questionnaire we sent you on January 31, we apologize for intruding again, and we thank you sincerely for your promptness and participation.

If, on the other hand, it's still on your desk, may I appeal to you to pick it up, sharpen your pencil, and head for a quiet spot? We need your opinions very badly, and hope you'll take this opportunity to make them heard in determining some of the educational needs of our state. And we do thank you for taking the time to give us your input.

The Educational Development Corp.

Follow-up Postcard

APPENDIX BRAVO

This appendix comprises several pages related to the statewide survey of educational needs, as described in Chapter IV. Appendix Alfa includes the letters and forms mailed out; Appendix Bravo presents the statistical results.

On the following pages are:

1. Questionnaire responses Part A (1 side)
2. Questionnaire responses Part B (2 sides)
3. Questionnaire responses Part C (2 sides)
4. Questionnaire responses Part D (1 side)
5. Questionnaire responses Part E (1 side)
6. Questionnaire responses Part F (1 side)
7. Questionnaire responses Part G (1 side)
8. Questionnaire responses Educational Technology (2 sides)
9. Questionnaire responses Part H (Teachers) (2 sides).
10. Questionnaire responses Part H (Administrators) (1 side)
11. Questionnaire responses Part I (Administrators) (1 side)

PART A

To what extent is additional instruction (or lesser amounts of information) needed on the following topics so that teachers may improve instruction in the schools?

	Urgent Need			Moderate Need			Adequate As Is			Not Needed			Definitely Not Needed			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
1. Changing role of school	9 22.0	39 35.5	48 31.8	28 68.3	56 50.9	84 55.6	3 7.3	15 13.6	18 11.9	1 2.4	-- --	1 0.7	-- --	-- --	-- --	0 N/A	0	0
2. Structure of knowledge	5 12.2	14 12.7	19 12.6	21 51.2	61 55.5	82 54.3	15 36.6	33 30.0	48 31.8	-- --	2 1.8	2 1.3	-- --	-- --	-- --	0 N/A	0	0
3. Sources of content knowledge	3 7.3	16 14.5	19 12.6	19 46.3	47 42.7	66 43.7	18 43.9	46 41.8	64 42.4	-- --	1 0.9	1 0.7	1 2.4	-- --	1 0.7	0 N/A	0	0
4. Information reduction/ retrieval	3 7.5	25 23.4	28 19.0	13 32.5	45 42.1	58 39.5	18 45.0	31 29.0	49 33.3	4 10.0	4 3.7	8 5.4	2 5.0	2 1.9	4 2.7	1 N/A	3	4
5. Cognitive development	7 17.1	26 23.9	33 22.0	11 26.8	50 45.9	61 40.7	20 48.8	28 25.7	48 32.0	3 7.3	5 4.6	8 5.3	-- --	-- --	-- --	0 N/A	1	1
6. Learning styles	16 39.0	58 53.2	74 49.3	19 46.3	44 40.4	63 42.0	5 12.2	7 6.4	12 8.0	1 2.4	-- --	1 0.7	-- --	-- --	-- --	0 N/A	1	1
7. Open schools	3 7.3	16 14.7	19 12.7	9 22.0	45 41.3	54 36.0	16 39.0	27 24.8	43 28.7	9 22.0	11 10.1	20 13.3	4 9.8	10 9.2	14 9.3	0 N/A	1	1
8. Team teaching	8 19.5	24 22.0	32 21.3	15 36.6	57 52.3	72 48.0	10 24.4	21 19.3	31 20.7	7 17.1	5 4.6	12 8.0	1 2.4	2 1.8	3 2.0	0 N/A	1	1
9. Developing learning modules	13 31.7	44 40.0	57 37.7	14 34.1	46 41.8	60 39.7	8 19.5	16 14.5	24 15.9	4 9.8	4 3.6	8 5.3	2 4.9	-- --	2 1.3	0 N/A	0	0
10. Planning and organization for instruction	16 39.0	62 56.4	78 51.7	16 39.0	34 30.9	50 33.1	8 19.5	14 12.7	22 14.6	-- --	-- --	-- --	1 2.4	-- --	1 0.7	0 N/A	0	0
11. Educational applications of recorded media	5 12.2	26 23.6	31 20.5	24 58.5	63 57.3	87 57.6	11 26.8	20 18.2	31 20.5	1 2.4	1 0.9	2 1.3	-- --	-- --	-- --	0 N/A	0	0
12. Computers in school	5 12.5	16 14.5	21 14.0	14 35.0	44 40.0	58 38.7	9 22.5	27 24.5	36 24.0	7 17.5	18 16.4	25 16.7	5 12.5	5 4.5	10 6.7	1 N/A	0	1
13. Self-instructional systems	9 22.0	31 28.2	40 26.5	17 41.5	56 50.9	73 48.3	11 26.8	17 15.5	28 18.5	3 7.3	6 5.5	9 6.0	1 2.4	-- --	1 0.7	0 N/A	0	0
14. Affective teaching	13 31.7	55 50.0	68 45.0	14 34.1	47 42.7	61 40.4	13 31.7	6 5.5	19 12.6	1 2.4	2 1.8	3 2.0	-- --	-- --	-- --	0 N/A	0	0
15. Applied behavior modification	14 35.9	42 38.9	56 38.1	13 33.3	43 39.8	56 38.1	10 25.6	13 12.0	23 15.6	2 5.1	10 9.3	12 8.2	-- --	-- --	-- --	2 N/A	2	4

NOTE: Raw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

PART B

To what extent do you feel that teachers desire assistance in improving the overall performance of the following tasks?

	Urgent Need			Moderate Need			Adequate As Is			Not Needed			Definitely Not Needed			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
16. Diagnosing individual pupil learning difficulties	17 41.5	56 50.9	73 48.3	14 34.1	42 38.2	56 37.1	9 22.0	11 10.0	20 13.2	1 2.4	1 0.9	2 1.3	-- --	-- --	-- --	0 N/A	0	0
17. Prescribing individual instruction	17 41.5	47 42.7	64 42.4	15 36.6	48 43.6	63 41.7	7 17.1	12 10.9	19 12.6	1 2.4	3 2.7	4 2.6	1 2.4	-- --	1 0.7	0 N/A	0	0
18. Defining educational objectives	6 14.6	31 28.2	37 24.5	16 39.0	47 42.7	63 41.7	17 41.5	26 23.6	43 28.5	1 2.4	5 4.5	6 4.0	1 2.4	1 0.9	2 1.3	0 N/A	0	0
19. Presenting information interestingly	20 48.8	43 39.1	63 41.7	14 34.1	49 44.5	63 41.7	7 17.1	17 15.5	24 15.9	-- --	1 0.9	1 0.7	-- --	-- --	-- --	0 N/A	0	0
20. Motivating pupils to think for themselves	22 53.7	56 50.9	78 51.7	15 36.6	42 38.2	57 37.7	4 9.8	10 9.1	14 9.3	-- --	2 1.8	2 1.3	-- --	-- --	-- --	0 N/A	0	0
21. Relating instruction to everyday life situations	19 46.3	46 41.8	65 43.0	14 34.1	48 43.6	62 41.1	8 19.5	15 13.6	23 15.2	-- --	1 0.9	1 0.7	-- --	-- --	-- --	0 N/A	0	0
22. Communicating with pupils of diff. ethnic/racial backgrounds	15 36.6	40 36.7	55 36.7	14 34.1	44 40.4	58 38.7	12 29.3	21 19.3	33 22.0	-- --	4 3.7	4 2.7	-- --	-- --	-- --	0 N/A	1	1
23. Communicating with pupils of diff. socio/eco. backgrounds	13 31.7	36 32.7	49 32.5	16 39.0	47 42.7	63 41.7	12 29.3	23 20.9	35 23.2	-- --	4 3.6	4 2.6	-- --	-- --	-- --	0 N/A	0	0
24. Devising testing/measuring instruments	10 24.4	24 21.8	34 22.5	11 26.8	35 31.8	46 30.5	18 43.9	40 36.4	58 38.4	2 4.9	11 10.0	13 8.6	-- --	-- --	-- --	0 N/A	0	0
25. Involving students in self-evaluation	7 17.1	26 23.6	33 21.9	23 56.1	46 41.8	69 45.7	10 24.4	31 28.2	41 27.2	1 2.4	6 5.5	7 4.6	-- --	1 0.9	1 0.7	0 N/A	0	0
26. Assigning grades	4 9.8	11 10.1	15 10.0	15 36.6	39 35.8	54 36.0	18 43.9	44 40.4	62 41.3	2 4.9	14 12.8	16 10.7	2 4.9	1 0.9	3 2.0	0 N/A	1	1
27. Directing student investigations	3 7.3	14 12.8	17 11.3	14 34.1	53 48.6	67 44.7	19 46.3	33 30.3	52 34.7	4 9.8	9 8.3	13 8.7	1 2.4	-- --	1 0.7	0 N/A	1	1
28. Questioning strategies	5 12.2	30 27.3	35 23.2	21 51.2	43 39.1	64 42.4	13 31.7	33 30.0	46 30.5	2 4.9	2 1.8	4 2.6	-- --	2 1.8	2 1.3	0 N/A	0	0
29. Stating objectives in measurable terms	5 12.2	28 25.5	33 21.9	20 48.8	51 46.4	71 47.0	16 39.0	26 23.6	42 27.8	-- --	3 2.7	3 2.0	-- --	2 1.8	2 1.3	0 N/A	0	0
30. Communicating with pupils in nonstructured situations	9 22.0	34 30.9	43 28.5	17 41.5	43 39.1	60 39.7	13 31.7	26 23.6	39 25.8	1 2.4	7 6.4	8 5.3	1 2.4	-- --	1 0.7	0 N/A	0	0

NOTE: Raw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

PART B
(Continued)

	Urgent Need			Moderate Need			Adequate As Is			Not Needed			Definitely Not Needed			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
31. Selecting/developing materials	10 24.4	39 35.8	49 22.7	16 39.0	47 43.1	63 42.0	11 26.8	20 18.3	31 20.7	3 7.3	3 2.8	6 4.0	1 2.4	-- --	1 0.7	0 N/A	1	1

NOTE: Raw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

PART C

To what extent do teachers need assistance in teaching the following skills/processes more effectively?

	Urgent Need			Moderate Need			Adequate As Is			Not Needed			Definitely Not Needed			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
32. Spoken English	9 22.0	26 23.6	35 23.2	14 34.1	57 51.8	71 47.0	18 43.9	25 22.7	43 28.5	-- --	1 0.9	1 0.7	-- --	1 0.9	1 0.7	0 N/A	0	0
33. Written sentence construction	11 26.8	28 25.7	39 26.0	19 46.3	54 49.5	73 48.7	11 26.8	23 21.1	34 22.7	-- --	3 2.8	3 2.0	-- --	1 0.9	1 0.7	0 N/A	1	1
34. Vocabulary development	16 39.0	34 30.9	50 33.1	17 41.5	54 49.1	71 47.0	8 19.5	21 19.1	29 19.2	-- --	-- --	-- --	-- --	1 0.9	1 0.7	0 N/A	0	0
35. Accurate spelling	15 36.6	30 27.8	45 30.2	15 36.6	53 49.1	68 45.6	11 26.8	22 20.4	33 22.1	-- --	2 1.9	2 1.3	-- --	1 0.9	1 0.7	0 N/A	2	2
36. Expository writing	8 19.5	30 27.5	38 25.3	21 51.2	56 51.4	77 51.3	11 26.8	21 19.3	32 21.3	1 2.4	2 1.8	3 2.0	-- --	-- --	-- --	0 N/A	1	1
37. Persuasive writing	10 24.4	26 23.9	36 24.0	17 41.5	55 50.5	72 48.0	13 31.7	25 22.9	38 25.3	1 2.4	3 2.8	4 2.7	-- --	-- --	-- --	0 N/A	1	1
38. Creative writing	12 29.3	45 41.3	57 38.0	19 46.3	47 43.1	66 44.0	9 22.0	17 15.6	26 17.3	1 2.4	-- --	1 0.7	-- --	-- --	-- --	0 N/A	1	1
39. Speaking a foreign language	7 17.5	19 17.6	26 17.6	19 47.5	46 42.6	65 43.9	12 30.0	35 32.4	47 31.8	1 2.5	5 4.6	6 4.1	1 2.5	3 2.8	4 2.7	1 N/A	2	3
40. Writing a foreign language	5 12.5	15 13.9	20 13.5	19 47.5	32 29.6	51 34.5	13 32.5	47 43.5	60 40.5	2 5.0	10 9.3	12 8.1	1 2.5	4 3.7	5 3.4	1 N/A	2	3
41. Reading for meaning	26 63.4	61 56.0	87 58.0	9 22.0	34 31.2	47 28.7	6 14.6	13 11.9	19 12.7	-- --	-- --	-- --	-- --	1 0.9	1 0.7	0 N/A	1	1
42. Reading in content subjects	14 34.1	50 45.9	64 42.7	18 43.9	39 35.8	57 38.0	9 22.0	19 17.4	28 18.7	-- --	-- --	-- --	-- --	1 0.9	1 0.7	0 N/A	1	1
43. Stating problems in abstract terms	9 22.5	32 29.4	41 27.5	18 45.0	44 40.4	62 41.6	12 30.0	29 26.6	41 27.5	1 2.5	3 2.8	4 2.7	-- --	1 0.9	1 0.7	1 N/A	1	2
44. Abstract reasoning	12 29.3	38 34.9	50 33.3	18 43.9	46 42.2	64 42.7	10 24.4	21 19.3	31 20.7	1 2.4	2 1.8	3 2.0	-- --	2 1.8	2 1.3	0 N/A	1	1
45. Arithmetic concepts	12 29.3	33 30.6	45 30.2	18 43.9	54 50.0	72 48.3	11 26.8	17 15.7	28 18.8	-- --	1 0.9	1 0.7	-- --	3 2.8	3 2.0	0 N/A	2	2
46. Analysis of a problem or question	16 39.0	41 38.0	57 38.3	15 36.6	47 43.5	62 41.6	10 24.4	18 16.7	28 18.8	-- --	2 1.9	2 1.3	-- --	-- --	-- --	0 N/A	2	2

NOTE: Raw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

PART C
(Continued)

	Urgent Need			Moderate Need			Adequate As Is			Not Needed			Definitely Not Needed			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
47. Formulating hypotheses	9 22.0	30 27.8	39 26.2	19 46.3	49 45.4	68 45.6	12 29.3	25 23.1	37 24.8	1 2.4	4 3.7	5 3.4	-- --	-- --	-- --	0 N/A	2	2
48. Finding sources of information	6 14.6	35 32.4	41 27.5	23 56.1	49 45.4	72 48.3	12 29.3	23 21.3	35 23.5	-- --	-- --	-- --	-- --	1 0.9	1 0.7	0 N/A	2	2
49. Finding relevant information	7 17.1	34 31.5	41 27.5	21 51.2	57 52.8	78 52.3	13 31.7	16 14.8	29 19.5	-- --	-- --	-- --	-- --	1 0.9	1 0.7	0 N/A	2	2
50. Note taking/information recording skills	4 9.8	23 21.3	27 18.1	26 53.4	55 50.9	81 54.9	10 24.4	27 25.0	37 24.8	1 2.4	2 1.9	3 2.0	-- --	1 0.9	1 0.7	0 N/A	2	2
51. Organizing information	12 29.3	41 37.3	53 35.1	15 36.6	58 52.7	73 48.3	13 31.7	10 9.1	23 15.2	1 2.4	1 0.9	2 1.3	-- --	-- --	-- --	0 N/A	0	0
52. Synthesizing information	8 19.5	42 38.2	50 33.1	21 51.2	51 46.4	72 47.7	11 26.8	16 14.5	27 17.9	1 2.4	1 0.9	2 1.3	-- --	-- --	-- --	0 N/A	0	0
53. Enhancing creative approaches	12 29.3	47 43.1	59 39.3	18 43.9	47 43.1	65 43.3	10 24.4	14 12.8	24 16.0	1 2.4	1 0.9	2 1.3	-- --	-- --	-- --	0 N/A	1	1
54. Building performance skills	13 32.5	39 36.1	52 35.1	21 52.5	50 46.3	71 48.0	6 15.0	17 15.7	23 15.5	-- --	2 1.9	2 1.4	-- --	-- --	-- --	1 N/A	2	3

NOTE: Paw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

PART D

In which of the following content areas of instruction do you feel that the use of media and technology would be most useful in helping to improve the quality of pupil learning?

	Urgent Need			Moderate Need			Adequate As Is			Not Needed			Definitely Not Needed			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
55. Language arts	11 26.8	39 36.4	50 33.8	19 46.3	50 46.7	69 45.6	11 26.8	18 16.8	29 19.6	-- --	-- --	-- --	-- --	-- --	-- --	0 N/A	3	3
56. Mathematics	15 36.6	40 36.7	55 36.7	17 41.5	45 41.3	62 41.3	9 22.0	23 21.1	32 21.3	-- --	1 0.9	1 0.7	-- --	-- --	-- --	0 N/A	1	1
57. Science	20 48.8	56 50.9	76 50.3	15 36.6	47 42.7	62 41.1	6 14.6	7 6.4	13 8.6	-- --	-- --	-- --	-- --	-- --	-- --	0 N/A	0	0
58. Social studies	16 39.0	50 45.5	66 43.7	17 41.5	47 42.7	64 42.4	8 19.5	12 10.9	20 13.2	-- --	1 0.9	1 0.7	-- --	-- --	-- --	0 N/A	0	0
59. Foreign language	13 31.7	30 27.5	43 28.7	18 43.9	45 41.3	63 42.0	7 17.1	32 29.4	39 26.0	2 4.9	2 1.8	4 2.7	1 2.4	-- --	1 0.7	0 N/A	1	1
60. Fine arts	11 26.8	28 25.5	39 25.8	16 39.0	57 51.8	73 48.3	12 29.3	24 21.8	36 23.8	2 4.9	1 0.9	3 2.0	-- --	-- --	-- --	0 N/A	0	0
61. Vocational education	17 42.5	43 39.1	60 40.0	16 40.0	55 50.0	71 47.3	5 12.5	11 10.0	16 10.7	1 2.5	1 0.9	2 1.3	1 2.5	-- --	1 0.7	1 N/A	0	1
62. Career education	20 50.0	49 44.5	69 46.0	16 40.0	54 49.1	70 46.7	3 7.5	7 6.4	10 6.7	1 2.5	-- --	1 0.7	-- --	-- --	-- --	1 N/A	0	1
63. Physical education	5 12.5	17 15.5	22 14.7	21 52.5	50 45.5	71 47.3	11 27.5	35 31.8	46 30.7	3 7.5	7 6.4	10 6.7	-- --	1 0.9	1 0.7	1 N/A	0	1
64. Special education	20 50.0	46 42.2	66 44.3	12 30.0	47 43.1	59 39.6	8 20.0	14 12.8	22 14.8	-- --	2 1.8	2 1.3	-- --	-- --	-- --	1 N/A	1	2

NOTE: Raw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

PART E
Assuming that adequate equipment and programming were available, how necessary and desirable are each of the following telecommunications technologies as an aid to improving instruction in your school?

	Urgent Need			Moderate Need			Adequate As Is			Not Needed			Definitely Not Needed			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
65. Audio cassettes or tapes	19 48.7	61 55.5	80 53.7	14 35.9	39 35.5	53 35.1	6 15.4	10 9.1	16 10.7	-- --	-- --	-- --	-- --	-- --	-- --	2 N/A	0	2
66. Broadcast, cable, or closed circuit TV	9 22.0	34 30.9	43 28.5	21 51.2	55 50.0	76 50.3	9 22.0	12 10.9	21 13.9	2 4.9	9 8.2	11 7.3	-- --	-- ---	-- --	0 N/A	0	0
67. Video tape or recordings	10 24.4	45 41.3	55 36.7	20 48.8	54 49.5	74 49.3	8 19.5	9 8.3	17 11.3	3 7.3	1 0.9	4 2.7	-- --	-- --	-- --	0 N/A	1	1
68. Motion picture films	14 34.1	47 42.7	61 40.4	18 43.9	47 42.7	65 43.0	9 22.0	13 11.8	22 14.6	-- --	2 1.8	2 1.3	-- --	1 0.9	1 0.7	0 N/A	0	0
69. Long dist. sending/receiving of printed/pictorial info.	9 22.5	17 15.6	26 17.4	14 35.0	41 37.6	55 36.9	9 22.5	34 31.2	43 28.9	8 20.0	12 11.0	20 13.4	-- --	5 4.6	5 3.4	1 N/A	1	2
70. Dial access systems allowing pupil to call up information	10 24.4	31 28.4	41 27.3	17 41.5	49 45.0	66 44.0	5 12.2	17 15.6	22 14.7	8 19.5	9 8.3	17 11.3	1 2.4	3 2.8	4 2.7	0 N/A	1	1
71. TV systems that allow pupil responses to be recorded	10 24.4	31 28.4	41 27.3	14 34.1	46 42.2	60 40.0	4 9.8	18 16.5	22 14.7	11 26.8	12 11.0	23 15.3	2 4.9	2 1.8	4 2.7	0 N/A	1	1
72. Computer systems for individual instruction and testing	12 29.3	30 27.5	42 28.0	14 34.1	50 45.9	64 42.7	3 7.3	17 15.6	20 13.3	10 24.4	9 8.3	19 12.7	2 4.9	3 2.8	5 3.3	0 N/A	1	1
73. Audio sys. to listen/record/check/replay items	17 41.5	55 50.5	72 48.0	13 31.7	43 39.4	56 37.3	4 9.8	6 5.5	10 6.7	6 14.6	5 4.6	11 7.3	1 2.4	-- --	1 0.7	0 N/A	1	1

NOTE: Raw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

PART F

Given a situation in which adequate tapes, films, programs and accompanying equipment are available, what is the attitude that you think your school board would have toward using the technologies below in your school system if they were not provided through state funding and had to be paid for by local taxes and funding?

	Urgent Need			Moderate Need			Adequate As Is			Not Needed			Definitely Not Needed			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
74. Audio cassettes or tapes	12 29.3	41 38.3	53. 35.8	24 58.5	50 46.7	74 50.0	4 9.8	10 9.3	14 9.5	1 2.4	5 4.7	6 4.1	-- --	1 0.9	1 0.7	0 N/A	3	3
75. Broadcast, cable, or closed circuit TV	3 7.3	10 9.4	13 8.8	19 46.3	34 32.1	53 36.1	8 19.5	28 26.4	36 24.5	11 26.8	27 25.5	38 25.9	-- --	7 6.6	7 4.8	0 N/A	4	4
76. Video tape or recordings	7 19.1	19 17.9	26 17.7	18 43.9	41 38.4	59 40.1	9 22.0	30 28.3	39 26.5	7 17.1	14 13.2	21 14.3	-- --	2 1.9	2 1.4	0 N/A	4	4
77. Motion picture films	11 26.8	40 37.4	51 34.5	16 39.0	42 39.3	58 39.2	11 26.8	14 13.1	25 16.9	3 7.3	10 9.3	13 8.8	-- --	1 0.9	1 0.7	0 N/A	3	3
78. Long dist. sending/receiving of printed/pictorial info.	2 4.9	4 3.7	6 41.1	5 12.2	16 15.0	21 14.2	18 43.9	44 41.1	62 41.9	12 29.3	37 34.6	49 33.1	4 9.8	6 5.6	10 6.8	0 N/A	3	3
79. Dial access systems allowing pupil to call up information	1 2.4	3 2.8	4 2.7	7 17.1	18 16.8	25 16.9	18 43.9	41 38.3	59 39.9	12 29.3	37 34.6	49 33.1	3 7.3	8 7.5	11 7.4	0 N/A	3	3
80. TV systems that allow pupil responses to be recorded	1 2.4	6 5.6	7 4.7	12 29.3	21 19.6	33 22.3	11 26.8	37 34.6	48 32.4	14 34.1	38 35.5	52 35.1	3 7.3	5 4.7	8 5.4	0 N/A	3	3
81. Computer systems for individual instruction and testing	3 7.3	8 7.4	11 7.4	10 24.4	24 22.2	34 22.8	11 26.8	36 33.3	47 31.5	12 29.3	32 29.6	44 29.5	5 12.2	8 7.4	13 8.7	0 N/A	2	2
82. Audio sys. to listen/record/check/replay items	4 9.8	10 9.3	14 9.4	14 34.1	45 41.7	59 39.6	12 29.3	32 29.6	44 29.5	8 19.5	18 16.7	26 17.4	3 7.3	3 2.8	6 4.0	0 N/A	2	2

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PART G

Given a situation in which adequate tapes, films, programs and accompanying equipment are available, what is the attitude that you think that most parents in your district would have toward the use of the technologies below in your school system if they were not provided through state funding and had to be financed locally?

	Urgent Need			Moderate Need			Adequate As Is			Not Needed			Definitely Not Needed			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
83. Audio cassettes or tapes	10 24.4	38 34.9	48 32.0	24 58.5	51 46.8	75 50.0	5 12.2	16 14.3	21 14.0	2 4.9	4 3.7	6 4.0	-- --	-- --	-- --	0 N/A	1	1
84. Broadcast, cable, or closed circuit TV	4 9.8	11 10.1	15 10.0	17 41.5	41 37.6	58 38.7	11 26.8	36 33.0	47 31.3	7 17.1	21 19.3	28 18.7	2 4.9	-- --	2 1.3	0 N/A	1	1
85. Video tape or recordings	3 7.3	13 12.0	16 10.7	23 56.1	48 44.4	71 47.7	8 19.5	32 29.6	40 26.8	6 14.6	15 13.9	21 14.1	1 2.4	-- --	1 0.7	0 N/A	2	2
86. Motion picture films	12 29.3	38 34.9	50 33.3	16 39.0	46 42.2	62 41.3	8 19.5	21 19.3	29 19.3	4 9.8	4 3.7	8 5.3	1 2.4	-- --	1 0.7	0 N/A	1	1
87. Long dist. sending/receiving of printed/pictorial info.	2 4.9	6 5.6	8 5.4	9 22.0	16 14.8	25 16.8	17 41.5	49 45.4	66 44.3	9 22.0	35 32.4	44 29.5	4 9.8	2 1.9	6 4.0	0 N/A	2	2
88. Dial access systems allowing pupil to call up information	-- --	6 5.6	6 4.0	14 34.1	25 23.1	39 26.2	10 24.4	41 38.0	51 34.2	13 31.7	33 30.6	46 30.9	4 9.8	3 2.8	7 4.7	0 N/A	2	2
89. TV systems that allow pupil responses to be recorded	2 4.9	6 5.6	8 5.4	8 19.5	25 23.1	33 22.1	18 43.9	45 41.7	63 42.3	8 19.5	28 25.9	36 24.2	5 12.2	4 3.7	9 6.0	0 N/A	2	2
90. Computer systems for individual instruction and testing	3 7.3	5 4.6	8 5.4	9 22.0	31 28.7	40 26.8	16 39.0	36 33.3	52 34.9	10 24.4	34 31.5	44 29.5	3 7.3	2 1.9	5 3.4	0 N/A	2	2
91. Audio sys. to listen/record/check/replay items	4 9.8	12 11.1	16 10.7	16 39.0	41 38.0	57 38.3	13 31.7	33 30.6	46 30.9	6 14.6	22 20.4	28 18.8	2 4.9	-- --	2 1.3	0 N/A	2	2
92. Parental support of technology, given adequate funding	14 35.0	38 35.2	52 35.1	22 55.0	60 55.6	82 55.4	4 10.0	9 8.3	13 8.8	-- --	1 0.9	1 0.7	-- --	-- --	-- --	1 N/A	2	3

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EDUCATIONAL TECHNOLOGY

	Strongly Agree			Agree			Have No Opinion			Disagree			Strongly Disagree			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
93. Frees teacher from lecturing	9 22.0	47 43.1	56 37.3	19 46.3	46 42.2	65 43.3	1 2.4	3 2.8	4 2.7	9 22.0	12 11.0	21 14.0	3 7.3	1 0.9	4 2.7	0 N/A	1	1
94. Takes more teacher time	4 9.8	13 11.9	17 11.3	15 36.6	42 38.5	57 38.0	6 14.6	12 11.0	18 12.0	15 36.6	36 33.0	51 34.0	1 2.4	6 5.5	7 4.7	0 N/A	1	1
95. Improves teaching effectiveness	8 19.5	38 34.9	46 30.7	22 53.7	58 53.2	80 53.3	5 12.2	6 5.5	11 7.3	5 12.2	6 5.5	11 7.3	1 2.4	1 0.9	2 1.3	0 N/A	1	1
96. Requires more scheduling/ preparation time	9 22.0	37 33.6	46 30.5	25 61.0	54 49.1	79 52.3	1 2.4	11 10.0	12 7.9	6 14.6	8 7.3	14 9.3	-- --	-- --	-- --	0 N/A	0	0
97. Requires more time following up on pupils' learning	6 14.6	23 20.9	29 19.2	21 51.2	58 52.7	79 52.3	6 14.6	11 10.0	17 11.3	8 19.5	18 16.9	26 17.2	-- --	-- --	-- --	0 N/A	0	0
98. Creates disciplinary problems	1 2.4	3 2.7	4 2.6	3 7.3	4 3.6	7 4.6	13 31.7	10 9.1	23 15.2	21 51.2	62 56.4	83 55.0	3 7.3	31 28.2	34 22.5	0 N/A	0	0
99. Requires more teaching skills	7 17.1	15 13.6	22 14.6	10 24.4	52 47.3	62 41.1	13 31.7	14 12.7	27 17.9	11 26.8	27 24.5	38 25.2	-- --	2 1.8	2 1.3	0 N/A	0	0
100. Teacher loses scheduling control of pupil activities	1 2.4	4 3.7	5 3.4	1 2.4	2 1.9	3 2.0	10 24.4	11 10.2	21 14.1	26 63.4	65 60.2	91 61.1	3 7.3	26 24.1	29 19.5	0 N/A	2	2
101. Teacher loses control of what is taught	1 2.4	5 4.5	6 4.0	2 4.9	3 2.7	5 3.3	6 14.6	5 4.5	11 7.3	29 70.7	65 59.1	94 62.3	3 7.3	32 29.1	35 23.2	0 N/A	0	0
102. Necessitates too much coordination	1 2.4	-- --	1 0.7	7 17.1	5 4.5	12 7.9	8 19.5	5 4.5	13 8.6	20 48.8	70 63.6	90 59.6	5 12.2	30 27.3	35 23.2	0 N/A	0	0
103. Teachers need help of learning resources specialist	15 36.6	38 34.5	53 35.1	16 39.0	60 54.5	76 50.3	4 9.8	8 7.3	12 7.9	6 14.6	3 2.7	9 6.0	-- --	1 0.9	1 0.7	0 N/A	0	0
104. Requires addition of equipment maintenance specialist	12 29.3	29 26.4	41 27.2	15 36.6	50 45.5	65 43.0	9 22.0	16 14.5	25 16.6	4 9.8	14 12.7	18 11.9	1 2.4	1 0.9	2 1.3	0 N/A	0	0
105. Requires assistance of testing & measurement specialist	7 17.1	11 10.1	18 12.0	10 24.4	31 28.4	41 27.3	15 36.6	28 25.7	43 28.7	9 22.0	34 31.2	43 28.7	-- --	5 4.6	5 3.3	0 N/A	1	1
106. Teachers cannot write/develop/produce programs	6 14.6	10 9.1	16 10.6	10 24.4	26 23.6	36 23.8	11 26.8	16 14.5	27 17.9	10 24.4	52 47.3	62 41.1	4 9.8	6 5.5	10 6.6	0 N/A	0	0
107. Requires availability of design & production staff	12 29.3	21 19.1	33 21.9	20 48.8	57 51.8	77 51.0	4 9.8	18 16.4	22 14.6	5 12.2	14 12.7	19 12.6	-- --	-- --	-- --	0 N/A	0	0

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	Highly Desirable			Desirable			Undecided			Undesirable			Highly Undesirable			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
108. Independent home study	6 14.6	19 17.3	25 16.6	11 26.8	38 34.5	49 32.5	12 29.3	35 31.8	47 31.1	10 24.4	16 14.5	26 17.2	2 4.9	2 1.8	4 2.6	0	0	0

	Prefer Individ-ualization			Lean Toward Individ-ualization			Equal Amounts			Prefer Interaction			Definitely by Groups			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
109. Individualized materials or group training session	3 7.3	9 8.3	12 8.1	5 12.2	16 14.8	21 14.1	21 51.2	44 40.7	65 43.6	5 12.2	28 25.9	33 22.1	7 17.1	11 10.2	18 12.1	0	2	2

	Technology Guarantees Security			Technology Better			Undecided			Technology Loses Control			Everyone Vulnerable			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
110. Accountability vs. Technology	-- --	1 0.9	1 0.7	33 80.5	94 87.0	127 85.2	5 12.2	11 10.2	16 10.7	2 4.9	1 0.9	3 2.0	1 2.4	1 0.9	2 1.3	0	2	2

	Very Skilled			Skilled			Undecided or Unknown			Slightly Skilled			Very Unskilled			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
111. Beginning teacher skills	-- --	1 0.9	1 0.7	7 17.1	13 12.1	20 13.5	10 24.4	15 14.0	25 16.9	21 51.2	61 57.0	82 55.4	3 7.3	17 15.9	20 13.5	0	3	3

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PART H - TEACHERS

Indicate on your answer sheet your willingness to use the technologies listed below to improve your skills through in-service activities during released time from instruction during the school day.

	Very Willing			Willing			Undecided			Unwilling			Very Unwilling			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
112. Broadcast or cable TV	10 24.4			19 46.3			9 22.0			3 7.3			-- --			-- --		
113. Computer based instruction	7 17.1			16 39.0			12 29.3			6 14.6			-- --			-- --		
114. Motion picture film	12 29.3			23 56.1			4 9.8			2 4.9			-- --			-- --		
115. Videorecordings	9 22.0			23 56.1			9 22.0			-- --			-- --			-- --		
116. Audio tapes or cassettes	16 39.0			21 51.2			3 7.3			-- --			1 2.4			-- --		
117. Automated info. searches providing biblio. citations	2 4.9			13 31.7			23 56.1			3 7.3			-- --			-- --		
118. Automated info. searches with facsimile transmission	1 2.4			13 31.7			23 56.1			3 7.3			1 2.4			-- --		
119. Dial access systems with videodisplay	1 2.4			18 43.9			19 46.3			2 4.9			1 2.4			-- --		

Indicate on your answer sheet your willingness to use the technologies listed below to improve your skills through inservice activities held after school or accomplished on your own time outside the school day.

	Very Willing			Willing			Undecided			Unwilling			Very Unwilling			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
120. Broadcast or cable TV	-- --			15 37.5			13 32.5			8 20.0			4 10.0			1 --		
121. Computer based instruction	2 4.9			13 31.7			13 31.7			10 24.4			3 7.3			-- --		
122. Motion picture film	1 2.4			21 51.2			6 14.6			10 24.4			3 7.3			-- --		
123. Videorecordings	2 4.9			19 46.3			11 26.8			6 14.6			3 7.3			-- --		
124. Audio tapes or cassettes	6 14.6			21 51.2			6 14.6			4 9.8			4 9.8			-- --		
125. Automated info. searches providing biblio. citations	2 4.9			7 17.1			20 48.8			8 19.5			4 9.8			-- --		

NOTE: Raw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

PART H - TEACHERS
(Continued)

	Very Willing			Willing			Undecided			Unwilling			Very Unwilling			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
126. Automated info. searches with facsimile transmission	1 2.4			9 22.0			18 43.9			9 22.0			4 9.8			-- --		
127. Dial access systems with videodisplay	2 4.9			13 31.7			15 21.1			7 17.1			4 9.8			-- --		

NOTE: Raw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

PART H - ADMINISTRATORS
If the programming and software for telecommunications were provided for all schools in Texas by the state, indicate the portion of the cost for each item that you would be willing to bear from local funds in order to have the programming available to pupils in your school.

	None			0-25%			26-50%			51-75%			76-100%			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
112. Long distance transmission costs		36 37.1			47 48.5			9 9.3			5 5.2			-- --			13	
113. Antenna systems to receive signals		20 20.8			45 46.9			17 17.7			10 10.4			4 4.2			14	
114. System to distribute signals throughout building		13 13.7			45 47.4			25 26.3			10 10.5			2 2.1			15	
115. Television receivers (sets)		9 9.4			35 36.5			26 27.1			13 13.5			13 13.5			14	
116. Rental/lease of computer terminals		24 25.0			44 45.8			18 18.7			6 6.3			4 4.2			14	
117. Recording equipment to record transmissions for later time		11 11.6			37 38.9			29 30.5			14 14.7			4 4.2			15	
118. Printed programmed instruction		10 10.5			44 46.3			21 22.1			15 15.8			5 5.3			15	
119. Staff to assist pupils in use		14 14.7			40 42.1			25 26.3			8 8.4			8 8.4			15	
120. Maintenance personnel to repair equipment		18 18.7			38 39.6			22 22.9			9 9.4			9 9.4			14	
121. Additional programming costs for software		25 27.2			45 48.9			14 15.2			6 6.5			2 2.2			18	

NOTE: Raw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

PART I - ADMINISTRATORS
Please express your views about the needs or uses for each of the services described in 122-129, using these meanings for A through E:

	Urgent Need			Moderate Need			Adequate As Is			Not Needed			Definitely Not Needed			Unusable Responses		
	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot	T	A	Tot
122. Telecommunications sys. for querying cost estimates		21 20.2			54 51.9			16 15.4			10 9.6			3 2.9			6	
123. Dissemination program for administrators		44 41.1			56 52.3			5 4.7			2 1.9			-- --			3	
124. Awareness service for significant literature		30 28.0			60 56.1			11 10.3			6 5.6			-- --			3	
125. Awareness service for education opportunities		27 26.0			63 60.6			12 11.5			2 1.9			-- --			6	
126. Summaries/updates of new curricular developments		38 35.5			58 54.2			9 8.4			2 1.9			-- --			3	
127. Summaries/updates of new instructional materials		39 36.4			59 55.1			8 7.5			1 0.9			-- --			3	
128. Summaries/updates of developing technologies		35 33.0			61 57.5			10 9.4			-- --			-- --			4	
129. Research summaries of learning theories and concepts		33 31.7			59 56.7			12 11.5			-- --			-- --			6	

NOTE: Raw data numbers appear in the top part of each box; adjusted percentages appear in the lower portion of each box.

APPENDIX CHARLIE

SUMMARY OF COMMUNICATION NETWORK PARTICIPATION BY TEXAS LIBRARIES*

(As referenced in Chapter V, "Existing Telecommunications Networks in Texas," page V-21)

INSTITUTIONS	CORAL	ESC	IIS	IUC	NETINA	RICE	SETINA	TAGER	TALON	TEKNET	TEMP	TIE	TSLCH	WIN
STATE LIBRARY										3		4	*	
PUBLIC LIBRARIES														
Abilene Public Library												4	*	3
Amarillo Public Library												4	*	3
Austin Public Library										3		4	*	
Corpus Christi Public Library										3		4	*	
Dallas Public Library					3							4	*	
El Paso Public Library												4	*	3
Fort Worth Public Library					3							4	*	
Houston Public Library							3					4	*	
Lubbock City-County Public Library												4	*	3
San Antonio Public Library	*									3		4	*	
PUBLIC SENIOR COLLEGES & UNIVERSITIES														
Angelo State University				4								*		*
East Texas State University				4	1							*		
Lamar State College of Technology			4	4		*	3					*		
Midwestern University				4								*		*
North Texas State University			4	*	1							*	4	
Pan American College			4			*	3					4		
Prairie View A & M College				4			3					*		
Sam Houston State University			4	4		*	3					*		
Southwest Texas State University	*			4						3	*	*		
Stephen F. Austin State University			4	4		*	3					*	4	
Sul Ross State University				4								*		*
Tarleton State University														3
Texas A & I University			4			*				3		4		
Texas A & M University			4		3	*						*	4	
Texas Southern University			4	4	3	*						*		
Texas Tech University				4								*	4	*
Texas Woman's University			4	*	1							4	4	

* Participating member of active network

1. Member of developing network
2. Member of cooperative but not network participant
3. In geographic area of HB 692 Information Network Region
4. Interchange to network now available

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*Taken from Texas Library Association, Reference Round Table, Directory Information Networks in Texas (Arlington, Texas: Interuniversity Council of North Texas Area, 1971), pp. 54-58.

PUBLIC SENIOR COLLEGES & UNIVERSITIES CONT'D.	CORAL	ESC	IIS	IUC	NETINA	RICE	SETINA	TAGER	TALON	TEXNET	TEMP	TIE	TSLCN	WIN
The University of Texas - Arlington			4	*	1							*	4	
The University of Texas - Austin				4						3	*	*	4	
The University of Texas - Dallas				2	1			*						
The University of Texas - El Paso				4								*		*
The UT Dental Branch - Houston				4			3					*		
The UT Medical Branch - Galveston				4			3		*			*		
The UT Medical School - San Antonio	*			4					*	3		*		
The UT Medical School - Dallas			4	*	1				*			*		
University of Houston			4	4		*	3					*	4	
West Texas State University				4								*		*
PRIVATE SENIOR COLLEGES & UNIVERSITIES														
Abilene Christian College														*
Austin College				2	3			*				4		
Baylor College of Medicine - Houston							3							
Baylor University				4						3		*	4	
Baylor University College of Dentistry - Dallas				2	3									
Bishop College			4	*	3			*				4		
Dallas Baptist College				2	3			*						
Dominican College							3							
East Texas Baptist College					3									
Hardin-Simmons University														*
Howard Payne College														*
Houston Baptist College			4			*	3					4		
Huston-Tillotson College										3	*			
Incarnate Word College	*									3				
Jarvis Christian College					3									
Le Tourneau College					3									
Mary Hardin-Baylor College										3				
McMurry College														*
Northwood Institute					3									
Oblate College of the Southwest	*									3				
ur Lady of the Lake College	*									3	*			
Paul Quinn College										3				
St. Edward's University										3	*			
St. Mary's University	*									3	*			
South Texas College of Law							3							
Southern Methodist University			4	*	3			*				*	4	
Southwestern University										3				
Southwestern Union College					3									
Texas Christian University			4	*	3			*				*	4	
Texas College					3									
Texas Lutheran College	*									3				
Texas Wesleyan College				2	3			*						
Trinity University	*									3	*			
University of Corpus Christi										3				
University of Dallas			4	*	3			*						

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PRIVATE SENIOR COLLEGES & UNIVERSITIES CONT'D.	CORAL	ESC	IIS	IUC	NETINA	RICE	SETINA	TAGER	TALON	TENNET	TEMP	TIE	TSLCN	WIN
University of St. Thomas			4			*	3					4		
Wayland Baptist College														*
Wiley College					3									
William Marsh Rice University			4	4		*	3					*	4	
PUBLIC JUNIOR COLLEGES														
Alvin Junior College							3							
Amarillo College														*
Angelina College							3							
Bee County College										3				
Blinn College							3							
Brazosport Junior College							3							
Central Texas College										3				
Cisco Junior College														3
Clarendon College														*
College of the Mainland							3							
Cooke County Junior College					1									
Dallas County Junior College District					1									
Del Mar College			4			*				3		4		
Frank Phillips College														*
Galveston College							3							
Grayson County College					1									
Henderson County Junior College					3									
Hill Junior College					1									
Howard County Junior College														*
Kilgore College					1									
Laredo Junior College			4			*				3		4		
Lee College							3							
McLennan Community College										3				
Navarro Junior College					3									
Odessa College														*
Panola College					3									
Paris Junior College					1									
Ranger Junior College														3
San Antonio College	*									3	*			
St. Philip's College	*									3				
San Jacinto College							3							
South Plains College														*
Southwest Texas Junior College										3				
Tarrant County Junior College District					1									
Temple Junior College										3				
Texarkana College					1									
Texas Southmost College			4			*				3		4		
Tyler Junior College					1									
Victoria College			4			*	3					4		
Weatherford College					1									
Wharton County Junior College			4			*	3					4		

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	CORAL	ESC	IIS	IUC	NETINA	RICE	SETINA	TAGER	TALON	TEXNET	TEMP	TIE	TSLCN	WIN
PRIVATE JUNIOR COLLEGES														
Allen Academy							3							
Christian College of the Southwest					3									
Concordia College										3				
Fort Worth Christian College					3									
Gulf Coast Bible College							3							
Jacksonville College					3									
Lon Morris College					3									
Lubbock Christian College														*
Schreiner Institute										3				
Southern Bible College							3							
South Texas Junior College							3							
Southwestern Assemblies of God College					3									
Southwestern Christian College					3									
ELEMENTARY AND SECONDARY SCHOOLS		*			3		3			3				3
INDUSTRIAL LIBRARIES			*	4	3	4	3							
OTHER PARTICIPATING LIBRARIES IN TEXAS														
Brook General Hospital, Ft. Sam Houston	*									3				
Houston Academy of Medicine Library							3		*					
M. D. Anderson Hospital, Houston							3					*		
South Central Regional Medical Libraries, Dallas					3			*				*		
Southwest Foundation for Research, San Antonio	*									3				
Southwest Research Institute, San Antonio	*									3				
Texas Medical Association Library, Austin									*	3				
USAF Medical Center, Lackland AFB	*						3							
AMFSS Library, Ft. Sam Houston	*						3							
PARTICIPATING LIBRARIES OUTSIDE OF TEXAS														
McNeese State College, Lake Charles, La.						*								
Louis St. University Medical Center, New Orleans									*			4		
Louisiana State University School of Medicine, Shreveport									*			4		
University of Arkansas Medical Center, Little Rock									*			4		
University of Oklahoma Medical Center, Oklahoma City									*			4		
University of New Mexico Medical Center, Albuquerque									*			4		

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APPENDIX DELTA

1974-1975 EDUCATION SERVICE CENTER COMPUTER PROCESSING FACILITIES*

(As referenced in Chapter V, "Existing Telecommunications Networks in Texas," page V-35)

Computer Processing Center	Central Processing Hardware	Regional Education Service Center	Method of Delivering Services to Education Service Center
Gulf Texas Multi-Regional Processing Center (Located at Region 4 Education Service Center)	Control Data Corporation 6600 Computer; IBM 370/145 Computer	4 (Houston) 5 (Beaumont) 6 (Huntsville)	Central Processor Terminal Terminal
North Texas Multi-Regional Processing Center (Located at Region 10 Education Service Center)	IBM 370/145 Computer; Hewlett-Packard 2000F Computer for Interactive Instructional Applications	9 (Wichita Falls) 10 (Richardson) 12 (Waco)	Terminal Central Processor Transport
South Texas Multi-Regional Processing Center (Located at Region 20 Education Service Center)	IBM 370/145 Computer; Hewlett-Packard 2000F Computer for Interactive Instructional Applications	1 (Edinburg) 2 (Corpus Christi) 3 (Victoria) 13 (Austin) 14 (Abilene) 15 (San Angelo) 18 (Midland) 20 (San Antonio)	Terminal Terminal Terminal Terminal Terminal Transport (Processing submitted through Region 14 terminal) Terminal Central Processor
Region 7 Processing Center (Located at Kilgore Junior College)	IBM 360/40 Computer	7 (Kilgore) 8 (Mount Pleasant)	Central Processor Transport
Region 11 Processing Center (Located at Fort Worth ISD)	Univac 70 Computer	11 (Fort Worth)	Central Processor
Region 16 Processing Center (Located at West Texas State University)	Digital Equipment Corporation DEC KI-10 Computer	16 (Amarillo)	Central Processor
Region 17 Processing Center (Located at Region 17 Education Service Center)	IBM 360/40 Computer	17 (Lubbock)	Central Processor
Region 19 Processing Center (Located at Region 19 Education Service Center)	IBM 370/135 Computer	19 (El Paso)	Central Processor

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*Taken from Texas Education Agency, Network-System Plan for Computer Services (Austin, Texas: TEA, March 1975), pp. 2-3.

APPENDIX ECHO

These few pages give descriptions of the technologies, devices and materials that are considered as alternatives in this report. This appendix is not intended as a glossary, nor does it provide complete coverage of all available or conceivable technologies.

Audio card, slide, page--A thin card-stock, 12" or less in width, with a stripe of 1/4" audio tape across the bottom. Sounds recorded on the tape are 10 seconds or less in duration; two track (recorded audio and response) and four track cards are available.

Audio tape--A magnetic tape on which audio signals can be recorded and stored, and from which sounds can be reproduced.

Book--A nonperiodical printed publication comprising at least 49 pages, exclusive of the covers, and made available to the public.

CAI/CMI (CAI)--Aspects of interactive instruction which utilizes a computer for presentation. The term includes the activities, supplies, and equipment and facilities involved. The items are general enough to apply to any CAI system, but they do assume, as an entry point, that a CAI system and language have been chosen.

Chart--A systematic arrangement of facts in graphic or pictorial form, presenting for convenient reference comparisons of quantity, distributions, trends, summaries, etc.

Computer magnetic tape--A strip of material which may be punched, coated or impregnated with magnetic or optically sensitive substances, used for data input-storage or output.

Digital cassette--A cassette containing stored, digitally formatted, computerized information.

Facsimile--The electronic copying, transmission, and reproduction of written, printed or graphic materials via telephone circuits. The process is accomplished by spinning drum and optical scanning (black and white only).

Filmstrip--A length of film that presents a sequence of related still pictures for projection. Most filmstrips are on 35mm film, but some are 16mm or smaller. A filmstrip is single-frame if the horizontal axis of the pictures is perpendicular to the sprocket holes; it is double-frame if the horizontal axis of the pictures is parallel to the sprocket holes. It may or may not have provision for sound accompaniment. (If it does not have sound, then it usually is accompanied by captions printed on the frame and/or a printed script provided to supplement the images.)

Hollerith card (computer card)--A card punched with a pattern of holes to represent data.

Holographic image--A 3-dimensional image produced spatially using the physical phenomenon of holography (light interference). Although no screen is required, the image must be viewed at the correct angle.

Holographic record (hologram)--An image having the illusion of three dimensions, complete with parallax, created by a photographic technique that utilizes a laser.

Interactive TV--Two-way television communications. Such an arrangement may be simplex (alternating transmission over one wideband channel) or duplex (simultaneous transmissions over two wideband channels).

Journal (periodical)--A publication which constitutes one issue in a continuous series under the same title, published more than twice a year over an indefinite period, with individual issues in the series numbered consecutively or each issue dated.

Mark-sense card--A Hollerith type card or large sheet, marked with pencil, and read out by optical scanning. It is usually used for testing or diagnostics; responses are multiple choice, yes-no, or variable, but never open-ended.

Microform--Material which has been photographically reduced in size for purposes of storage and protection (e.g., microcard, microfilm, microfiche) and must be read with the help of enlarging instruments.

Overhead transparency--A transparent sheet up to 10" x 10" in size which contains projection images for overhead transparency projection.

Pamphlet, etc.--A nonperiodical printed publication comprising at least 5 but not more than 48 pages, exclusive of the covers.

Phonodisc (audiodisc, record, phonorecord)--A disc with special grooves which cause a stylus to vibrate and produce sound.

Picturephone--A Bell Telephone patented process of two-way transmission of voice and live television-type images over wideband channels provided by the telephone company.

Picture set (picture)--A representation made by painting, drawing, or photography.

Polarized overhead transparency--A transparent sheet up to 10" x 10" in size which contains projection images for overhead transparency projection. Since there is both vertical and horizontal polarization, a sense of motion is created. Special transparencies and projector are required.

Printed page--Two-dimensional information displays, including books, diagrams, pictures (with captions), etc.

Punched paper tape--A coded, perforated paper tape containing discrete information, used to activate a teleprinter or storage device.

Radio--The transmission of radio signals on designated frequencies, including AM (amplitude modulation), FM (frequency modulation), and shortwave bands.

Silent motion picture--A length of film, without a magnetic or optical sound track, bearing a sequence of images which create the illusion of movement when projected at standard speed. For school use, standard film sizes are 16mm, 8mm, or Super 8.

Silent TV--A television broadcast or playback without sound.

Simulator--A training device that performs like the actual equipment or system it represents. Frequently a mock-up is used as a simulator.

Slides--A transparent photographic image for projection. The actual image area may vary from microform to 3-1/4" x 4". The 3-1/4" x 4" size usually is called a "lantern slide"; most other sizes are mounted in a 2" x 2" cardboard or plastic frame or mount.

Slow scan TV--The transmission, temporary storage, and display of visual images over voice channels with an image change occurring periodically, e.g., about every 30 seconds. Accompanying audio transmission is continuous.

Sound filmstrip--A filmstrip accompanied by a recorded narration in audio disc or audio tape form. The recording contains a signal which indicates when the filmstrip should be advanced; the signal is sometimes "silent" and may automatically advance the filmstrip in the projector.

Sound motion picture--A length of film, with a magnetic or optical sound track, bearing a sequence of images which create the illusion of movement when projected at standard speed. For school use, standard film sizes are 16mm, 8mm, or Super 8.

Sound-on-slide--A 2" x 2" slide with a brief audio tape recording on the frame. It is designed for projection with accompanying sound and requires a special sound-on-slide projector.

Sound page (magnetic)--A specially prepared printed page with sound equipment.

Sound-slide set--A transparent photographic image for projection. Actual image area may vary from microfilm to 3-1/4" x 4"; the 3-1/4" x 4" size usually is called a "lantern slide," while most other sizes are mounted in a 2" x 2" cardboard or plastic frame or mount.

Still videorecord--Stored video images, either pictures or printed materials, displayed on a large TV-type screen.

Talking book--A spoken text recorded either on audio tape or on an audio disc (generally at 16-2/3 rpm, but also sometimes at 33-1/3 rpm), available to the general public but intended particularly for use by the visually handicapped.

Telephone--A transmission system using regular telephone wires and handling voice frequencies of 200-3000 Hz.

Teleprinter--A typewriter-like terminal used for sending and receiving typed or printed information, at speeds up to 400 words/minute.

Television (broadcast, open circuit)--The transmission of television signals on designated frequencies which can be picked up by the normal (VHF and UHF) television receiver.

Television (CATV, cable television)--A special form of closed circuit television which distributes television programs either received from broadcast sources or originated at the CATV station via coaxial cable to the home, office, institution or other location of the television receiver. In most cases, CATV is a service, usually commercial, concerned with the delivery of a high quality television signal rather than with the programming which the system carries. The operator of the system is required to provide at least one free channel for educational purposes.

Television (CCTV, closed circuit television)--A television system which distributes television signals only to those receivers which are directly connected to the origination point by coaxial cable or by special microwave link.

Telewriting--The transmission of handwritten materials over a telephone line and their display at the destination. This is usually accomplished as the same speed at which the instructor writes or draws. Voice may accompany the written material. There are several methods for observing, transmitting, and displaying the written material.

Toys, games, realia, etc.--A toy is any play item which has value in developing physical or mental capacities and manipulative and motor skills, in addition to its pleasure and recreation value. Realia are tangible objects, real items (as opposed to representations or models). Games are collections of items designed to be used according to prescribed rules for either mental or physical competition.

Video cassette--Magnetic tape, either 1/2", 3/4" or 1", used to record pictures and sound for television use and enclosed in a magazine or hard plastic case containing a reel or two of tape. Reel-to-reel cartridges allow the tape movement to be controlled in both directions. Endless-loop or continuous-loop cartridges can continue to play indefinitely, but do not permit rewinding at will.

Video file--A method of storing printed materials on standard videotape. One tape can contain 108,000 images or pages. By buffering, single pages can be displayed for reading on oversize TV screens for as long as desired.

Video/floppy disc--A disc of magnetic tape that records synchronized images and sound. Playing time varies from 5 to 20 minutes or more; the disc is played back on a videoplayer for display on a regular television set.

Videorecorded telewriting--This method involves the same materials as regular telewriting, but they are recorded as a videoprocess on tape or cassette, and presented when desired. Although the method loses the interactive capability, it lends itself to large screen projection.

Video tape (pre-recorded)--A magnetic tape on which audio and visual images have been recorded for television use, varying from 1/4 to four inches in width and from 1/2 to 1-1/2 mil. in thickness. Conventional school use employs tapes 1/2", 3/4" or 1" in width. The tape may be in cartridge or cassette format.